Popular Science

Founded MON

"Glider" Coasting Is Newest Outdoor Sport (Page 21)

FEBRUARY 300 Pictures of New Inventions 25 CENTS

Have *You* Learned To Typewrite Yet?

Or do you still use the tiring, laborious hand-writing which is practically out of date? In hundreds of homes there are Olivers for the use of the entire family. Typing is fast becoming universal.

Free Trial

The coupon brings the Oliver to your office or home for 5 days' trial. Judge for yourself. Keep it or return it.

Easy Terms

The Oliver can be bought on easy monthly installments and you have the use of it while paying. Read our liberal offer.

Which: A Standard Typewriter for $100? A Standard Typewriter for $49.50?

We do not mean to ask a ridiculous question—but it is just what you face nowadays in buying a typewriter.

Sold in the usual manner, the price of a standard typewriter is $100 or more, the established price for over 25 years.

Sold direct from the factory in the Oliver way, the price is half. You save the cost of selling.

We have found that it costs $50.50 to sell a typewriter in the usual manner. Likewise, we found that it was unnecessary to maintain an expensive force of salesmen and agents, and costly branch houses in 50 cities.

Be Your Own Salesman

Our new plan of selling has multiplied our production four times over, and that also helps us offer new economies.

So today the Oliver offer is the most liberal of all—a brand new, standard typewriter for only $49.50 cash, or $55 in installments. Remember, this is possible only because of our simplified selling plan and enlarged output. The price would still be $100 if we sold in the usual manner.

Note, also, that you get a brand new machine, our latest and best model, a 25-year development. Why, even a rebuilt typewriter costs considerably *more*.

Over 900,000 Olivers have been sold. The Oliver is a favorite among big businesses as well as among individuals. It is famous for its speed, easy operation, durability and fine work.

A Severe Test

The coupon brings the Oliver for Five Days' Free Trial. When the Oliver comes, use it as if it were your own. Compare it. Then if you agree that it is the finest typewriter, regardless of price, and want to buy it, send us $49.50 cash. Or if you wish to pay in installments, the price is $55, payable $3 after trial, then $4 per month.

If you want to return the Oliver, ship it back at our expense. You do not risk a penny—we even refund the outgoing transportation charges.

Through the trial you are your own judge—no salesman need urge you. You can imagine that it takes the finest kind of a typewriter to face a trial like this.

Mail the Coupon Now

Make this Oliver test. See if you want to save the $50.50, or if you would rather pay $100. The trial costs you nothing. Nor does it obligate you to buy.

Note that the coupon brings EITHER a Free Trial Oliver or Further Information. Check which you wish. Then send the coupon immediately, so as to insure early delivery of your free trial Oliver.

Canadian Price, $79

The OLIVER Typewriter Company

1102 Oliver Typewriter Bldg., Chicago, Ill.

SAVE $50.50 THIS EASY WAY

THE OLIVER TYPEWRITER COMPANY,
1102 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $55 as follows: $3 at the end of trial period and then at the rate of $4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit to you $49.50.
If I decide not to keep it, I will ship it back at your expense at the end of five days.

My shipping point is.....

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name .....

Street Address .....

City..... **State**.....

Occupation or Business.....

Popular Science Monthly

February, 1922; Vol. 100, No. 2
25 Cents a Copy; $3 a Year

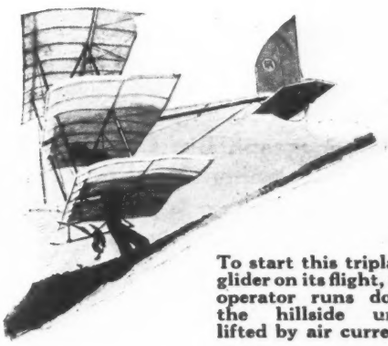
Published in New York City at
225 West Thirty-ninth Street

Coasting in the Air Becomes the World's Most Thrilling Sport

American Flying Enthusiasts Experiment with Novel Motorless Soaring Machine

YANKEE imaginations, set whirring by the lately discovered possibilities of soaring flight, are already turning to glider experiments.

Neglected by us, until recently revived in Germany, this great new sport of air coasti-g is now certain to win its due from the land of the brothers Wright—and even you who read this may some day find yourself soaring, motorless like a bird high over towns and valleys, with only the wind to rely on.



To start this triplane glider on its flight, the operator runs down the hillside until lifted by air currents

"GO!"

At your command, men at the wing-tips release their hold. A giant sling snaps your engineless plane from the high hillside out into the air to soar above the countryside without power other than that supplied by the veering wind and the force of gravity.

How far can you and your plane rise above the starting-point? How far can you travel before you are forced to land? It will all depend on your daring, on your skill in taking advantage of favorable winds and on your machine design.

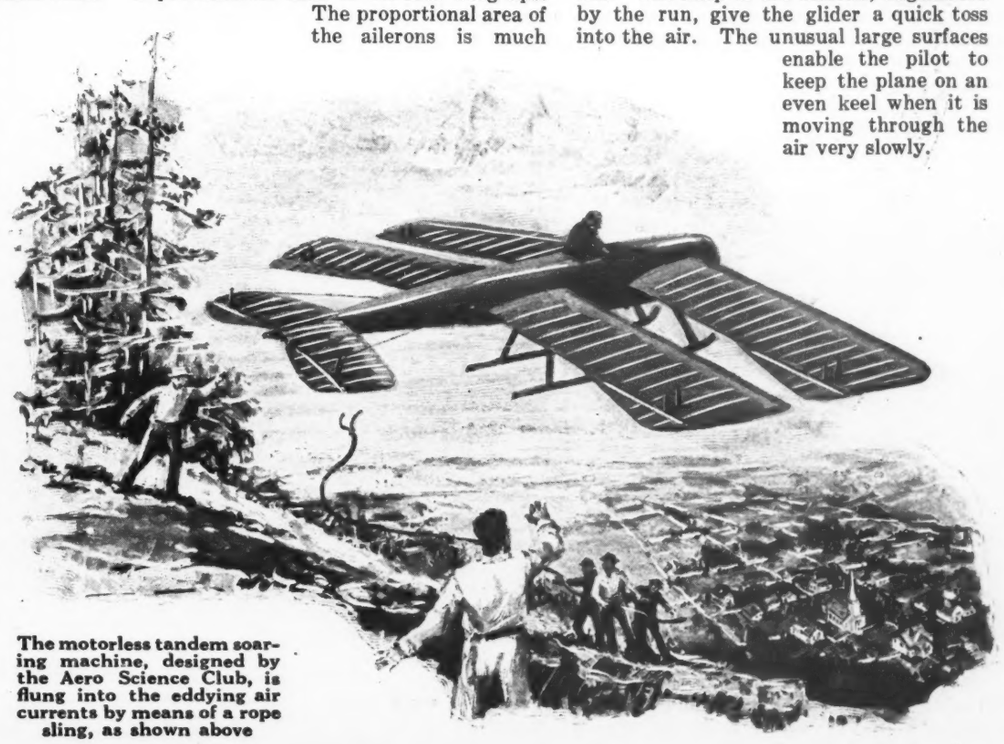
That is soaring—the newest sport—destined, perhaps, to become as popular as speedway races and gridiron battles. The sport was born when the Wright brothers and other daring pioneers in aviation made their early experiments with gliders. Today air-coasting is coming into its own as a spectacular pastime, while giving promise, as well, of new contributions to aviation.

The success of the spectacular German gliding and soaring contests in the Rhöne hills, described in the January issue of POPULAR SCIENCE MONTHLY, has already resulted in the announcement of a similar contest to be held in France next July. It is very probable that other competitions will be held during the summer in the United States, where individuals and organizations are becoming actively interested. The Aero Science Club of America, for one, is already at work on an engineless soaring machine.

Although the sport is still in its infancy, experts of the above-named organization believe the tandem type of glider will eventually prove most successful, and in consequence their machine consists of a fuselage with double, or tandem, wings and a fish-tail rudder. The operator sits in the center of the narrow, cylindrical fuselage and takes advantage of every favorable puff of wind by quick movements of the "stick" and foot controls.

The wings of this model are of the cantilever type, very thick in cross section, and have a pronounced sweep back. An aileron is provided for each of the four wing-tips. The proportional area of the ailerons is much greater than that of the motor-driven plane.

Because of improved knowledge of wing design, the glider of to-day is a reasonably safe machine. In the recent great German meet only one serious accident occurred. At present, the use of skids for landing-gear appears to be satisfactory, as is the catapult system of launching adopted by the Germans. Short pieces of strong elastic, such as strips cut from an old inner tube, are spliced into a rope about 40 feet long. The rope is slipped around the landing-gear of the glider while it rests on the summit or side of a hill. Two men hold the tips of the the glider's wings. The rest of the launching party, grasping the ends of the rope, walk downhill until they have stretched the elastic as far as possible. At a word from the flyer, the men holding the wings let go, and the others run rapidly downhill. The snap of the elastics, augmented by the run, give the glider a quick toss into the air. The unusual large surfaces enable the pilot to keep the plane on an even keel when it is moving through the air very slowly.



The motorless tandem soaring machine, designed by the Aero Science Club, is flung into the eddying air currents by means of a rope sling, as shown above

Phonograph Burglar Alarm Telephones Police

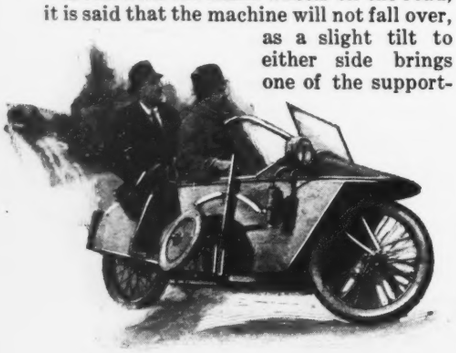
A PHONOGRAPH that automatically telephones the police department when any one tampers with a burglar-alarm system is the latest contrivance to put difficulties in the path of the thief. Wire connections from the doors and windows of a building lead to an electrically operated phonograph and telephone-receiver release. Any break in the circuit starts the machine going. A voice from the phonograph calls into the telephone the street and number of the house being robbed, and Central relays the call to the police station.

The device was invented by a fireman, William J. Jones, of New York City. Similar mechanism may be used as a fire alarm by putting a fusible plug into the circuit.

Motor Car-Cycle Can Run on Two or Four Wheels

CALLED by its German manufacturers a "single-track motor car," a vehicle recently introduced might be described either as a four-wheeled motorcycle or a two-wheeled auto. On slippery roads, or in city traffic when the speed must be considerably reduced, the small wheels at the sides of the car may be lowered to the road by pulling on a hand lever. Where the going is good, they are raised and the machine runs like a motorcycle.

Even with the small wheels off the road, it is said that the machine will not fall over, as a slight tilt to either side brings one of the supporting wheels into contact with the ground. From this position the machine can be righted by a twist of the handle-bars.



At the side of the car is one of two small wheels that can be lowered to the road by pulling a lever

The supporting wheels do not interfere in any way with the steering of the car. Their hubs are so fixed that they adjust themselves to the ground, and will roll nearly vertical even when the machine is leaning at an acute angle.

Paradoxes of Science

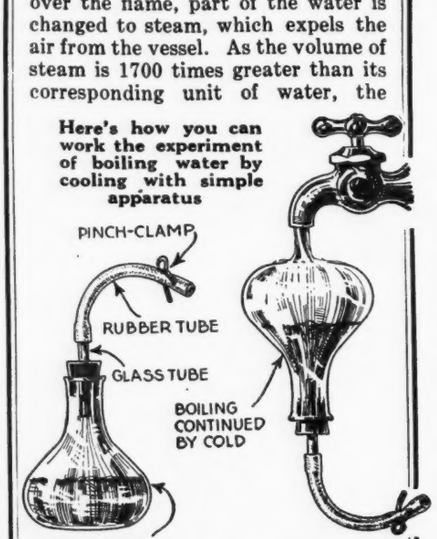
You Can Boil Water by Cooling It with Ice

WATER can be made to boil by cooling the vessel in which it is contained with cold water or ice. To prove this, half fill a thin glass flask with water and insert a tube in the neck. Then hold the flask over a burner until the water boils. While the steam is issuing from the tube, remove the flask and quickly make airtight with a pinch-clamp.

The flask may then be set aside until it has become merely tepid. If you let cold water run over the flask, the water within immediately begins to boil again. The colder the water applied, the greater the violence of the boiling.

The explanation lies in the fact that the temperature at which water boils depends upon atmospheric pressure. When the flask is placed over the flame, part of the water is changed to steam, which expels the air from the vessel. As the volume of steam is 1700 times greater than its corresponding unit of water, the condensation of the steam in the sealed flask reduces the vapor pressure. The pressure of the steam in the flask prevents the boiling of the water after the equilibrium has been reached. When the cold water or ice causes further condensation of the steam, the pressure is reduced and the water boils, producing enough steam to restore the disturbed balance of pressure.

Here's how you can work the experiment of boiling water by cooling with simple apparatus



PARACHUTE ABOUT TO BE DETACHED
PLANE WITH GRAPPLE CATCHING PARACHUTE
PARACHUTE WITH INCOMING MAIL-BAG
PARACHUTE WITH OUTGOING MAIL-BAG CAUGHT BY GRAPPLE
COMBINED BALLOON CABLE AND DETACHING WIRES

Will Planes Catch Mail-Bags with Grappling-Hooks?

BY picking up mail-bags with a grappling-iron while in flight, mail-planes could save an hour at every way station, declares Miss Katherine McDonald, aviatrix and motion-picture actress, of Los Angeles. Mail-planes usually fly at 10,000 feet, and lose 20 minutes or so in volplaning down to these intermediate stations, and about 40 minutes rising to flying height.

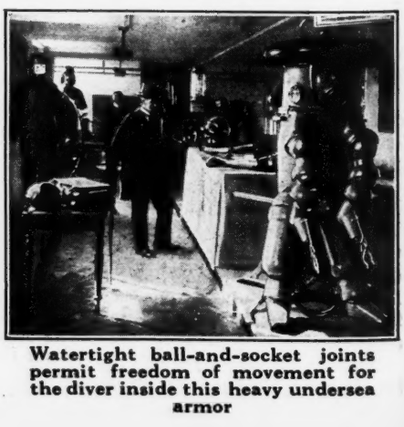
If a stationary balloon were sent up from the station at the approach of the mail-plane, and a parachute carrying the mail-pouches were released by a wire from the ground at a height of 5000 feet, the advocate of the plan avers that any seasoned aviator could dive, catch the parachute with a grappling-iron hung below his machine, and haul parachute and mail-bags aboard his plane without checking speed. Only the altitude and speed of the plane need be considered, for the height at which the parachute is released would be known, and the force of the wind would be the same both for parachute and plane.

The practicability of the scheme has already been proved, it is claimed, by a demonstration in which a parachute jumper was actually transferred to a diving plane in this way.

Armored Divers May Recover Treasures

A SUIT of heavy steel armor that protects the diver from the water pressure at great depths may permit the recovery of specie and cargoes valued at billions of dollars sunk during the war.

Watertight ball-and-socket joints allow freedom of movement, and a clever arrangement of pliers operated from inside the steel armor enables the diver to use tools. With such a suit it will be possible to recover material from ships sunk in water five hundred feet deep. At present two hundred feet is about the limit for effective underwater work. The record descent is three hundred feet, made by Crilley, a navy diver, during the sensational raising of the submarine F-4 from the harbor of Honolulu.



Watertight ball-and-socket joints permit freedom of movement for the diver inside this heavy undersea armor

Berries Stay Fresh on Long Trip

SUPPLIES of fresh California strawberries are now available in New York all winter as the result of improved methods of refrigeration and speedy transportation.

Berries are placed under low temperature right on the fields. There the filled containers, in special trays that require no covers, are loaded into special packing-cases in which provision is made for free circulation of air. These cases are then hauled to the railroad station in motor-trucks equipped with special double-walled bodies, ice-chests, and forced-ventilation systems.

At the station the berries go into cold storage until they can be transferred to refrigerator express cars. These "freezers" are then rushed eastward.

The berries travel in uncovered trays and airy packing-boxes

Firemen Carry Their Coffee-Pot

A "COFFEE wagon" that goes to all big fires during the winter season has just been added to the Cincinnati fire department's equipment. Suffering from cold while fighting fire is not such a paradox as it sounds, so the firemen decided recently that it would be better to mount a coffee-urn on the back of a light truck of their own providing than to depend upon the uncertain generosity of restaurant keepers near the fire.

The expenses of the coffee fund are met by a voluntary fund to which all the firemen contribute. Although Cincinnati originated the idea, its inventors declare emphatically that it is not copyrighted, and they recommend it to firemen in other cities.

Take Up Science for Your Health, Says Dr. Eugene Lyman Fisk

"THE man who interests himself in science has a boundless range of entertainment—a priceless, life-lengthening asset. A hobby of this kind is a protection against harmful indulgences, vacant-mindedness, mind-weariness, and boredom."

Dr. Eugene Lyman Fisk, medical director of the Life Extension Institute, thus urges an interest in popular science as an aid to health, pointing out that in periodic physical examinations, the men and women most fit are those who relax their minds at the end of the day by resorting to intellectual interests other than their jobs.

Poe's Dungeon Is Dentist's Chair for Tiger

DENTAL work on a tiger in the Cincinnati zoo was simplified by adopting a scheme from the tales of Edgar Allan Poe.

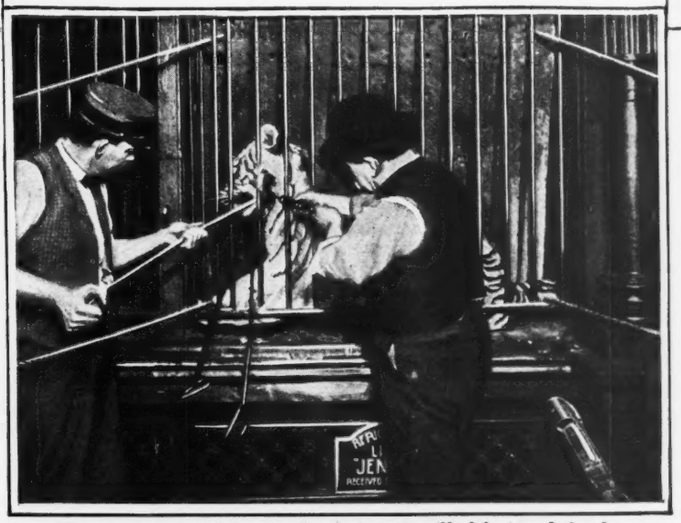
Superintendent Sol Stephan remembered the contracting walls of the iron dungeon in Poe's "Pit and the Pendulum."

The animal was induced to enter a narrow cage, the rear of which was fitted with a wooden partition that could be drawn forward by ropes. Slowly the tiger was forced up against the bars of the cage and pinioned there. After that it was a simple matter to treat the tooth.

Boy Digs Worms with Electricity

WHEN Joe Siegfried, aged eleven, of Kennewick, Wash., starts his electric tickler, from three to 14 big worms wriggle out to the surface between the electrodes, praying to get into the bait-can. All Joe has to do is to pick them up.

The boy drives two iron stakes into the ground about two feet apart, and connects them with the terminals of a hand magneto. As soon as he turns the crank, the earth between the stakes is charged with electricity, and the angleworms make a quick move from that vicinity.



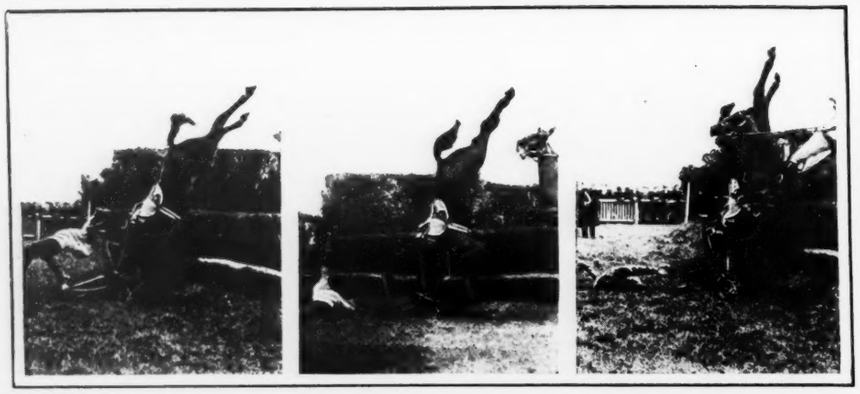
The wooden partition in the rear was pulled forward slowly, pinioning the animal against the front bars of the cage

Animals Die in Electric Chair

DOOMED dogs come to a painless death in an electric chair for animals recently perfected. Springs pressing firmly against the animal's body are used as electrodes, and the current employed is nearly as great as that used in penitentiary executions. At least 2200 volts are used, making death instantaneous.

The electric chair, which is closed by a sliding cover before an execution, has three heights to accommodate dogs and cats of various sizes. The operating switch is thrown by a woman attendant.

Three Cameras Snap Horse and Rider in Bad Tumble



© U. & U.

These photographs of a spectacular tumble were snapped by three different cameras at intervals of less than one one-hundredth of a second

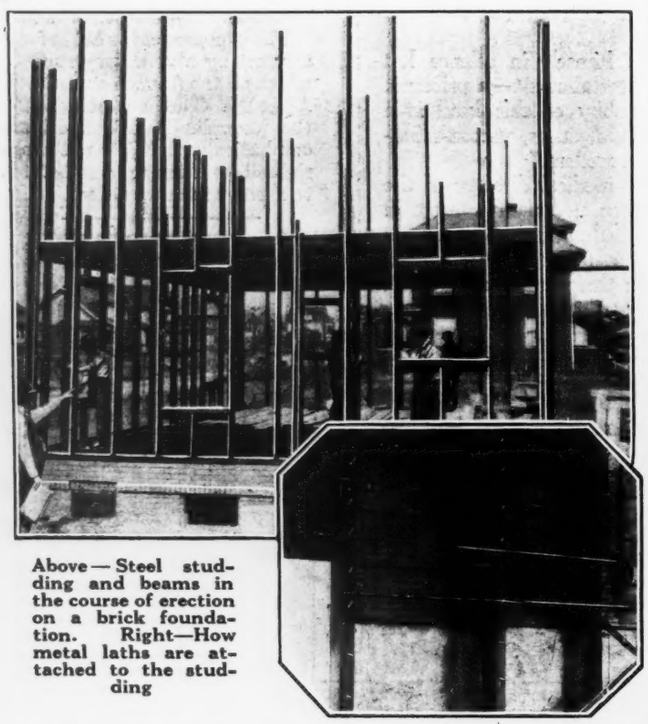
WHAT happens when a horse and rider fall in a steeplechase jump? The question was answered when three remarkable pictures of such an accident were snapped almost simultaneously by three different cameras at a recent meet near Sandown Park, England. The horse jumped short, and its foreleg was caught and held by the branches of the stiff hedge forming the obstacle. The rider was thrown headlong from the saddle, and the mount pitched forward head first, landing on its nose.

Man and mount were both badly hurt, because the horse was unable to recover.

Snapped at intervals of less than one one-hundredth of a second and from virtually the same viewpoint the three photographs form a unique and interesting action study.

Houses Built of Steel "Lumber"

METAL lumber has arrived. In a demonstration dwelling under construction in Canton, Ohio, joists and rafters of structural steel are used instead of wood. The steel framework is arranged so that it may be set on any kind of foundation, and



Above — Steel studding and beams in the course of erection on a brick foundation. Right—How metal laths are attached to the studding

finished on the exterior with any sort of brick or stucco the owner desires. No metal is visible in the completed dwelling.

Steel lumber is prepared in a number of designs for standardized houses. For each standard house, every metal joist, stud, and channel is supplied in the exact size required and is clearly marked for its place in the structure. The pieces are held in place with three-eighth and seven-sixteenth inch bolts.

The framing of the outer walls is of four-inch channel shapes with prongs punched on the inner and outer flanges for the quick and firm attachment of metal lath. The partitions are erected of two- or four-inch studs, on both sides of which expanded metal lath is attached. Plaster is then applied as in wooden houses.

The floors are built on steel beams spaced two feet apart. To the sides of these beams are bolted wooden nailing strips, to which the flooring is nailed. Similar nailing strips on the steel rafters permit any kind of roofing to be used.

Wood grounds are provided for the insertion of windows and door-frames and for all trimmings.

The advantages of the steel house, aside from increased strength and fire resistance, lie in the fact that the frame can be erected by three men faster than carpenters can saw, fit, and nail the lumber used in the ordinary dwelling.

More Pleasure from Your Car at Less Cost

HOW you can cut the cost of running your car will be described in detail in the March issue. You will find valuable tips, straight from the actual experiences of other automobile owners, in the articles submitted by POPULAR SCIENCE MONTHLY readers in the contest, "How I Keep Down Car Expenses," which opened in October. The most instructive of these articles will appear next month. Winners in the contest are:

First Prize, $35—F. A. Cuffe, 79 Hamilton Place, New York City.

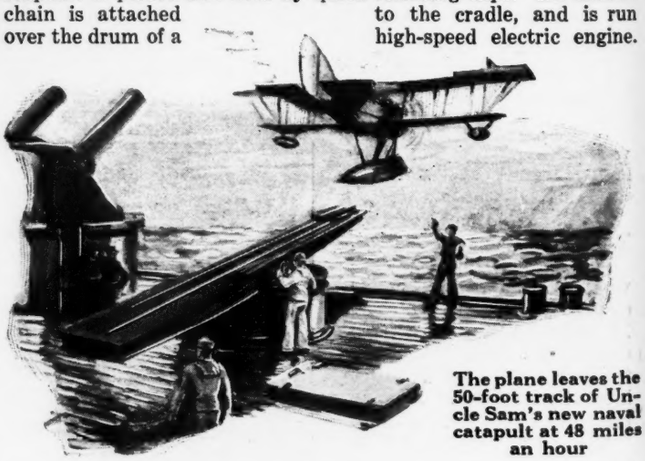
Second Prize, $15—W. Burr Bennett, Box 41, Honesdale, Pa.

Honorable Mention—R. A. Houston, South Charleston, O.; L. R. Fritz, Wymore, Neb., and Joe V. Romig, Allentown, Pa.

Planes Catapulted from Ships

CATAPULTS that hurl naval seaplanes into the air at a speed of 48 miles an hour, regardless of the direction in which the battleship is proceeding, may be added to the equipment of all American line-of-battle ships. Successful tests conducted recently at the Philadelphia navy yard indicate that at last, after years of experiment, naval engineers have invented a method by which airplanes can be shot from the deck like arrows from a bow.

The catapult consists of a grooved track about 50 feet long, mounted on a turntable so that it can be pointed into the wind independently of the deck or turret to which it is attached. On this track runs a small carriage, or cradle, on top of which the seaplane is placed and held by quick-releasing clips. An endless chain is attached to the cradle, and is run over the drum of a high-speed electric engine.



The plane leaves the 50-foot track of Uncle Sam's new naval catapult at 48 miles an hour

When this engine is started, cradle and plane move down the track at a rapidly accelerating speed until in 50 feet they are traveling at 48 miles an hour. At this point the cradle is suddenly stopped by powerful pneumatic brakes and shock-absorbers, the clips are released, and the plane is hurled into the air. In tests made with the two-seater NC9, the plane scarcely dipped three feet as it left the catapult.

Has the Earth a Tail Like a Comet?

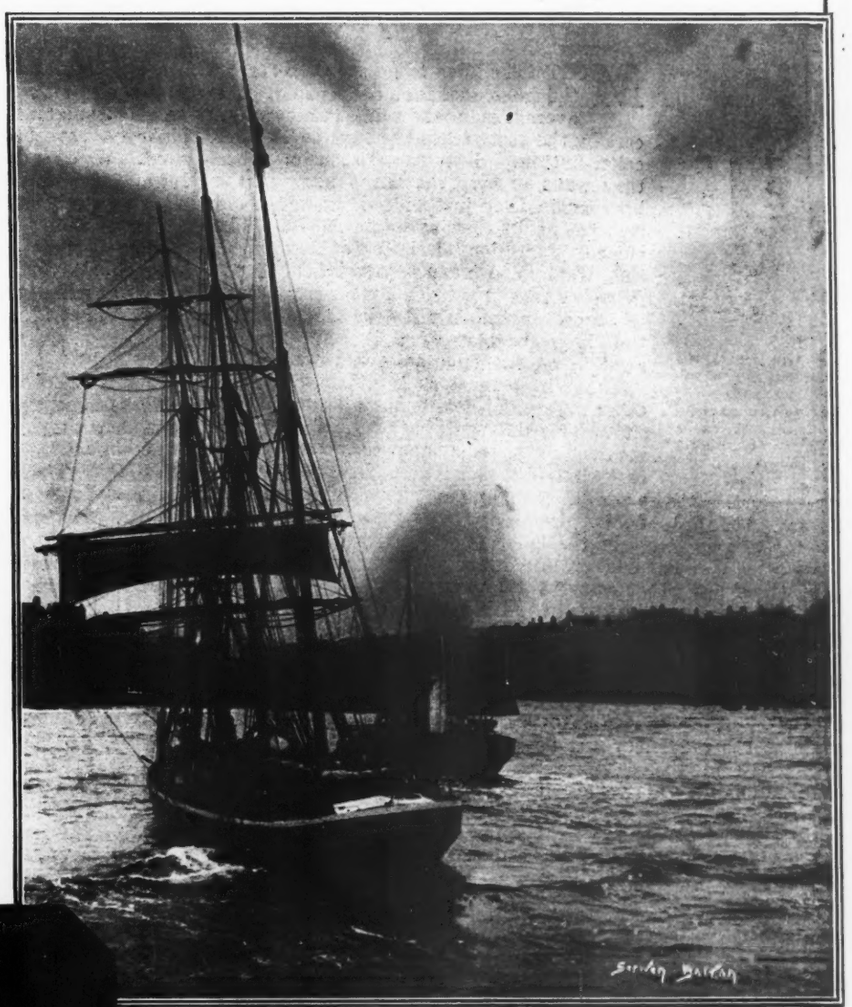
Some Astronomers Believe Mysterious Patch of Light in the Evening Sky Is Our Own "Luminous Shadow"

By Scriven Bolton, F.R.A.S.

AFTER sunset have you ever observed in the eastern sky a strange, diffused patch of light? If so, it is probable that you have seen the earth's tail! For astronomers who have studied this mysterious light patch have advanced the hypothesis that it represents, in perspective, a luminous appendage, streaming after the earth in its plunge through space. They call the spectacle the "Gegenshein." Usually it appears to have a diameter of 10 or 12 moons, but in clearer air its dimensions are increased sixfold.

Many Theories Advanced

Observers who have recently watched the object closely from stations in Egypt, India, and Arizona, have many theories to account for the apparent tail. One is that the two lightest gases, hydrogen and helium, are driven away from the earth by a repelling force from the sun, or by the sun's light pressure during its radiation into space. Another theory is that since the upper layers of our atmosphere are feebly self-luminous, due to some unknown solar action, the earth is surrounded by a luminous envelope, analogous to the light emitted by a comet's head. Because both comet light and earth light are dependent upon solar activity, this theory assumes that there should be a luminous tail to our earth corresponding to that of a comet, and that the patch of light seen in the sky represents such a tail.



The spot of radiance in the evening sky, as it was seen recently from Whitby Harbor, England, is reproduced in the above photograph taken at the time by Scriven Bolton, famous astronomer

If viewed from outer space, the mysterious light might appear as a cometlike tail streaming from the earth. Whether this apparent appendage is caused by gases or by refraction of the sun's light, is a matter of speculation among astronomers

From the mathematical side of the question, the phenomenon is attributed by Gylden and Moulton to sunlight reflected to the earth from countless moons, each less than the size of a marble, and describing oscillating orbits only on the night side of our planet. Such a theory, although plausible and vouched for by the mathematicians, is not generally accepted os representing the actual facts.

More readily accepted is the view of Prof. E. E. Barnard, of the Yerkes Observatory, who believes that the existence of a tail is caused in some way "by a concentration of the sun's light by refraction, our atmosphere acting as a spherical lens." Refracted sunlight, or light bent round into the earth's dark side, is indeed manifested during a lunar eclipse, when the earth's shadow, instead of being opaque, is luminous enough for a person easily to see the moon through it.

Earth's Shadow Illuminates

Thus the shadow of the earth really illuminates the moon, which shows that a cone of light is cast across space. Under favorable conditions the upper layers of the atmosphere may reflect these light-rays back to the earth.

Such a circumstance may help to explain the existence of a tail to the earth, the visibility of which may be enhanced by the fact that the upper layers of our atmosphere, instead of stopping short at 100 or 150 miles, might extend, even if of inconceivable tenuity, to the limit of the earth's gravitational influence, a distance of over 600,000 miles.

How the Radiophone Is Bringing the World to Wisconsin Firesides

Amazing Nightly Services of Music and Lectures now Echo through Air in Many Other States Also

Even the cowboy on the lonely range can be brought by wireless into vocal touch with men and events

For the man on the street, a wireless receiving-set that can be carried in the hat is a novelty of recent invention

By Armstrong Perry

MOST folks have to go at least as far as the front door for a daily paper. The average man who wants to hear a concert by the best artists has first to find his collar-button. But in Wisconsin, when they want to hear the latest news or the best music, they just slide down in the old armchair, shut their eyes, and listen. The current quotation on hogs in New York, the Weather Bureau's prediction of to-morrow's rain or sunshine, the silvery tones of Mabel Garrison's voice, or the results of the big game, play by play, come floating right in on the circumambient ether.

The Wisconsin story is simple. Like all other states, Wisconsin has a state university. This university has a physics department. In this department they study radio, or "wireless." Wisconsin has merely gone one step further than some other states, and given to all the people of the state the benefit of its wireless activities, instead of confining it to the few who work in the laboratory.

The physics department erected a radiophone transmitter that carries the human voice or instrumental music to receiving stations within the state and also to points as far away as Boston, Massachusetts, Houston, Texas, and Denver, Colorado. Even with a very simple and inexpensive receiver anything spoken into the transmitter at the university can be heard 60 miles away in the daytime and much farther at night. A simple, standardized receiver has been designed at the university and it is sold by a local manufacturer at a price within reach of most pocket books.

A Free Course at Home

For the benefit of folks living too far away to hear the radiophone at present with a low-priced receiver, the university is about to treble the range of its transmitter. For those who want to learn the dot-and-dash code and become radio operators, and those who can afford only the cheapest and crudest apparatus, the information sent by radio phone is repeated by radiograph. The dots and dashes can be heard much farther than the human voice. Three speeds are used—six words a minute for novices, 10 words a minute for average amateurs, and 20 words a minute for those who have passed the preliminary stages. So Wisconsinites have a free graded course in code in every home.

Plain instructions are sent to those who want to listen in. They are told that no license is needed for receivers; that the cost of apparatus ranges from $20 to several hundreds, according to the sensitivity and finish of the instruments; and that the beginner can construct much of the apparatus himself. The necessary units are described; instructions for installing them are given; the users are told what to listen for and when to listen. Radio books, magazines, and dealers are listed.

A complete operating schedule, giving the broadcasting program for each day in the week, with the exact hours for sending the weather forecast, market reports, concerts, and news, is supplied to all receivers.

If there is anything else the people of the state want, all they have to do is to ask for it. When Wisconsin's baseball or football teams are playing, the games are reported play by play. Weekly reports of the condition of highways have been given when desired. Weather reports for Illinois, Iowa, and Minnesota are to be supplied regularly each day.

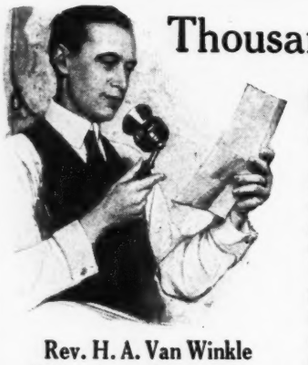
The system for sending and receiving market reports is unique in its simplicity. When he installs his receiver, the farmer gets a supply of mimeographed forms. He sits at his table with a form before him at 12:15 P.M. and he hears:

"QST QST QST de 9XM 9XM 9XM."

That is the preliminary signal. Next comes: "AB."

These same letters in parentheses on the first line of his printed form show the farmer that his pencil is in the right place and that he is about to receive the Live Stock Market Report for—"CHGO." That means Chicago. He moves down a line and sees and hears: "AC." The printed form tells him that that means: "Hogs: Estimated receipts for to-day—" The radio

Thousands Go to Church by Radio



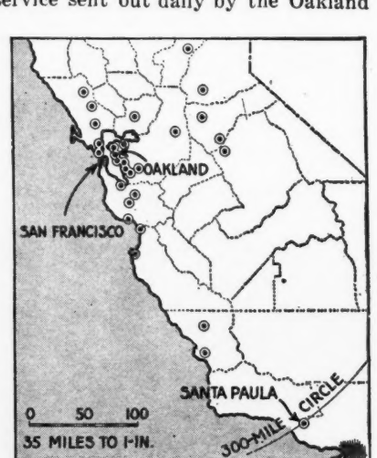
Rev. H. A. Van Winkle
Delivering his radiophone sermon to 32 congregations in California

CHURCH services by wireless telephone! In your home a sermon by a pastor, and music by a choir hundreds of miles away!

The Rev. H. A. Van Winkle, pastor of the First Christian church of Oakland, California, demonstrated recently to the Pacific Coast that radiophone preaching on Sunday is as entirely practical as newspaper despatches from Pittsburg (where it was tried a year ago) declared it to be. Standing at the top of an Oakland building, he delivered his Sunday-morning sermon and conducted a complete church service by radio—a service that was broadcasted to 32 congregations in the state of California. These congregations were in towns within a radius of 300 miles.. At the same time approximately 1000 wireless-telephone operators in the West, who customarily spend their Sundays tinkering with their apparatus, spent more than an hour at church.

The experiment was carried out by P. D. Allen, of Oakland, California, operator for a wireless-telephone news service sent out daily by the Oakland *Tribune*. Through the columns of the newspaper and by radio every wireless-telephone operator in the state equipped with a loud-speaker was requested to make arrangements to install it at some church in his town.

On the Sunday morning set for the service, the Rev. Van Winkle, accompanied by a church quartet and musicians opened the program from the wireless station on top of a hotel building. Because the hour for the services was at a time of the day when radio traffic was practically at a standstill, there was little interruption. This was confined to code messages at sea and from the station at Honolulu. There was one interruption, however. For a joke, an operator turned loose a jazz record just following the playing of sacred music. The jazz was heard only in the churches around Oakland, and, was received with suppressed amusement, not altogether without excuse, by the congregations.



California towns where congregations gathered to hear the Rev. Van Winkle's sermon are indicated by the small circles on the above map

What Will Radio Mean to You?

HOW the romance of radio is rapidly entering the life of the average man—the man who has no time to acquire technical knowledge of wireless secrets—has been related in recent articles in POPULAR SCIENCE MONTHLY.

Typical instances of radiophone broadcasting services, described on this and the preceding page, give a concrete idea of what wireless will mean to *you* within the next few months. The broadcasts here described merely represent a few of many similar enterprises now springing up all over the country.

POPULAR SCIENCE MONTHLY believes that government cooperation in radiophone expansion is now essential. Broadcasting stations of the kind here described are limited by license to a wave length of around 360 meters. It is argued that a much wider range should be assigned, in order to avoid conflict between different stations. Readers must remember that radiophone outfits are not yet perfect, and that messages are heard far less satisfactorily in some localites than they are in others.

receiver tells him how many. Next comes: "AF." This refers to the state of the market. Today's comment may be: "Fairly active. Ten to 25 higher. Packing and mixed hogs up most. Pigs steady."

Then follows:

"AG (meaning 'Top').....$8.25
"AH (meaning 'Bulk of sales').....$7.25 to 8.25
"AK (meaning 'Heavy weight (250 lbs. up) medium, good, and choice').....$7.60 to 8.20"

In a quarter of an hour he has the whole report—has it several hours ahead of the city man who waits for the newspaper to come out, and far ahead of the buyer who comes around to purchase his product.

Spoken letters are apt to be misunderstood because of similarity of sound, so in radiophoning a market report the university's operator uses the standard United States Navy Code. Instead of saying "A," he says "Able;" instead of "B," he says "Boy," and so on. If he uses the letters "BD," meaning "Good, choice, and prime beef steers," he says: "Boy Dog."

Resourceful Wisconsinites are making good use of the state's up-to-the-minute service. The Hotel Mazo, in Mazomanie, boasts on its business card that it is the first hotel in Wisconsin to feature a wireless receiving station. All over the state the farmers have discovered that a wire fence will catch radio messages and that they need not erect aerials. In Janesville the *Daily Gazette* was the first to test the standardized receiver and it got market reports and football scores earlier than ever before.

From a dozen or more states come reports that the messages are not only received, but posted at creameries, garages, and in store windows. An enterprising farmer in Pescatonia, Illinois, promptly installed a "Radio Bulletin Board," for the benefit of passers-by.

By the use of amplifiers and "loud speakers" the radiophone concerts are made loud enough so that thousands of persons in large auditoriums hear them. The Home Theater in Portage, Wisconsin, puts these concerts on its regular program.

The standardized receiver will bring in time signals and traffic from navy stations, so that jewelers and others may set their clocks and watches twice daily.

Professor Earle M. Terry, of the Department of Physics, has directed the radio work of the university since the radio station was erected in 1915-16. He designed and developed the power tubes employed in the tube transmitter.

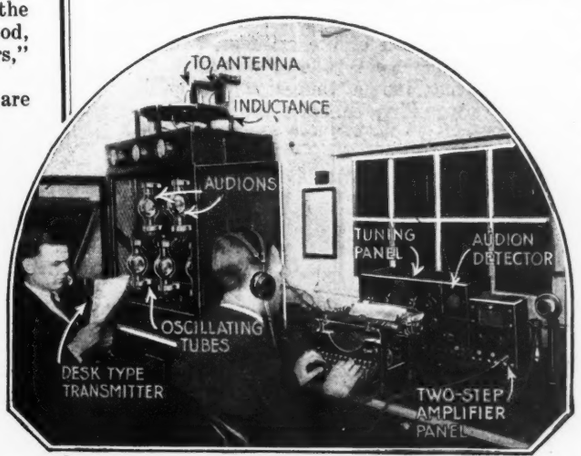
The Ether Is Now One Vast Concert Hall

SUPPOSE that in your own home, at any time, you were able to receive out of the air a summary of the important news of the hour, or you could hear a great public speaker, hundreds of miles away, or could enjoy a program of music by the world's greatest artists. And suppose that all you required to enjoy a service of this kind was a compact little cabinet and a coil of wire, which you could operate almost as easily as a talking-machine.

An audience of more than 50,000, scattered over an area of 12,000 square miles, heard the Misses Sarah and Nellie Kouns, shown above in the radiophone studio at Newark, New Jersey, during their concert

If all that were a fact, wouldn't you agree that a marvelous new agency for spreading information and pleasure had come into being?

Well, all that actually *is* a fact in some 50,000 American homes, scattered over an area of about 12,000 square miles. A radiophone broadcasting service has been received nightly during the past few months on so ambitious a scale as to mark the dawn of a new era in communication. Owners of radio receiving-sets in the Middle Atlantic states, and as far west as Indiana, are now hearing regularly a rapid-fire service of news, lectures, and music organized by the Westinghouse Electric and Manufacturing Company, (WJZ) in Newark, New Jersey. This service is already being rivaled by similar broadcasting enterprises planned by the Radio Corporation of America, and by the General Electric Company; and is paralleled by many already existing broadcasting stations.



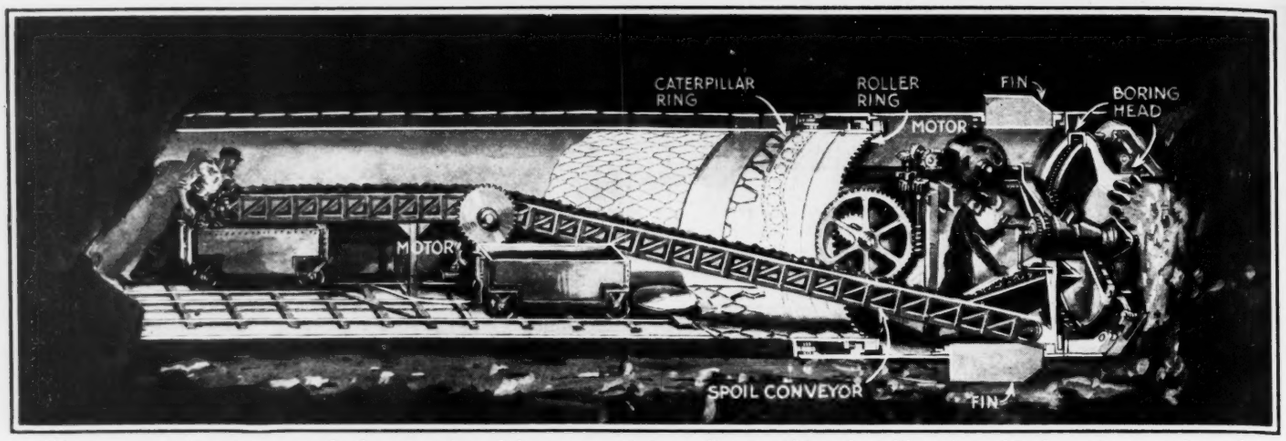
The operator's room on the roof of the Westinghouse plant at Newark, showing complete radiophone transmitter

It is a safe assumption that, within a year or two, similar regular radiophone broadcasting stations will be in operation in St. Louis, San Francisco, Philadelphia, Denver, and other cities, so that the nation will be blanketed with hourly radiophone broadcasts.

What the Westinghouse Company is doing takes on national significance. Dwellers in remote solitudes will hear the friendly voices of their fellow men. The prairie wife will sit at her sewing by the evening lamp, and listen to a concert by master musicians. The sheep-herder and the miner and the farmer will be kept in constant touch with world affairs by cheerful human voices speaking out of the night.

The Westinghouse experiment in Newark was preceded by an already well-known service from the same company's plant in Pittsburg, and has been followed by an elaborate service from the Chicago plant. The Newark station is distinguished, however, by its ambitious day-long program and by its ready access to the world's best music and vaudeville.

From ten in the morning till ten at night vocal entertainment is being shot into the ether on an announced schedule. Eight times a day a résumé of latest news is broadcasted. National sporting events are vividly described, play by play. At night a bedtime story is told, and thereafter a concert program begins. On Saturday night a service of dance music rides the air



The cut-away view above reveals the operation of the automatic tunneling machine that, like a huge bit, bores its way through earth and rock, simultaneously disposing of its "shavings" and building a concrete lining for the tube as it advances

Monster Earth-Devouring Machine Digs and Lines Tunnels as It Creeps

While Motor Driven Teeth Eat into the Ground, Automatic Masonry Layer Builds Conduits

PICTURE a giant, motor-driven bit that not only bores a clean hole through earth and rock, disposing of the debris, but simultaneously lines the walls of the tube with masonry as it creeps along, and you comprehend the possibilities of a new automatic tunneling machine invented by M. Roy Sheen, of Philadelphia, Pa.

In comparison, pick-and-shovel methods of open-cut and underground tunnel work appear crude; for the new machine completes the digging of a tunnel, the removal of the earth, and the bracing of the walls in a single operation! In a recent test performance on a construction job in Philadelphia, one of the machines completed 18 feet 8 inches of tunnel, 52 inches in diameter, in four hours running. The best run for one hour was five feet eight inches of finished tunnel. This boring was through schist rock; if the tunneling had been through earth or clay, undoubtedly the machine could have moved with much greater rapidity.

Masonry Layer Is Automatic

The only hand excavation necessary is the cutting of an opening large and deep enough to lower the machine to the depth desired for the tunnel.

Once its motor is started, the machine does all the work underground without breaking the surface. No back-fill and no bracing, forms, or shoring are required.

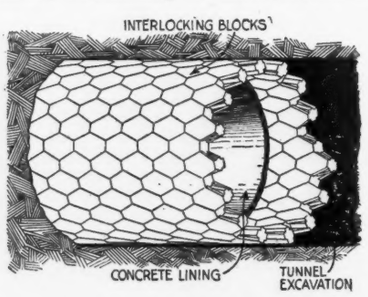
These advantages are obtained by a cutting head that eats into earth, clay, or soft rock, and a special masonry layer that automatically places a concrete block lining as the head moves forward. It follows that the complete machine has three working sections—the cutting head, the earth conveyor, and the helical lining constructor.

The cutting head consists of a steel drum with four revolving knives that loosen and scrape away the earth from the heading. Buckets attached to the arms collect the earth and throw it onto a belt conveyor, which in turn carries the earth to the rear and dumps it into cars. The cars run back through the finished tunnel to the shaft opening, where the excavated material is disposed of in the most convenient manner.

A 15-horsepower electric motor rotates the cutters and drives the conveying belt. In addition to this motion, the center of the cut may be shifted in any direction by the operation of hand wheels connected with adjustable eccentric cams that work against the outside of a set of movable teeth fitted on each of the revolving arms. Thus the course of the excavation may be changed. The line of the tunnel is directed by indicators and sightings taken by a surveyor's transit in the rear of the boring. A dial at the rear of the cams indicates the changes of direction, enabling the operator to take correct readings of the location of the cut made by the rotating knives. Four guide fins on the outside of the shell keep the machine on its course, and prevent it from tilting.

Directly behind the excavating drum is a helical tunnel-lining constructor. This is propelled by a roller bearing consisting of an endless chain of trucks secured together by ball-and-socket joints. The bearing is placed against the last block of the masonry lining. The pressure exerted by the caterpillar rollers against the block causes the forward motion of the cylinder, and forces the cutters against the heading.

As the machine advances, specially modeled, dovetailing concrete blocks are laid in a spiral course, either dry or in mortar. The hexagonal blocks are so proportioned that when they are pushed into place an expansion occurs until they fit snugly against the surrounding undisturbed earth as if they were an integral part of it. Thus the masonry at once becomes a brace. The shape and interlocking feature of the blocks produce a conduit with a perfect arch lining, it is claimed, so that cave-ins and settling virtually are impossible.



Hexagonal concrete blocks, interlocking, are laid as the machine advances, to produce a conduit with perfect arch action. The blocks are designed so that when they are pushed into place an expansion occurs that forces the tunnel lining tightly against the outer earth

This view through a tube constructed by the new tunneling machine shows the solid walls of masonry laid by the machine. In the background is a car receiving its load of earth from the automatic conveyor

Labor Costs Reduced

The advantages of the new machine are emphasized by a comparison of its work with the digging methods now in common use. The open-cut method requires the digging of a ditch and the piling up of excavated material near by for replacement. Side bracing must be installed to prevent cave-ins. In busy sections of a city this method means interruption of traffic, as well as costly replacement of surface.

The tunneling machine meets all these requirements automatically as it cuts its way; and in addition it cuts down labor costs. On the Philadelphia construction job, the test machine required only two experienced men to handle it. Two common laborers took charge of the concrete blocks and earth in the tunnel, and three others unloaded the earth and sent in the blocks. One engineer operated the gasoline-electric generating plant at the tunnel entrance by hand work.

How Strange Test Highway Is Being Smashed to Bits So You May Motor on Perfect Roads

Unique Scientific Instruments Reveal Strongest Kind of Pavement

IN order to make America's highways the best in the world, engineers at Pittsburg, Calif., are pounding a concrete road to bits under unique scientific test conditions. Day and night 40 heavy trucks loaded with pig iron are racing around a quarter-mile track made up of 13 sections of concrete pavement differing in design, in quality of concrete, and in the location and nature of reenforcement.

Thus the equivalent of 3000 to 4000 trucks, averaging eight tons in weight, passes over the road each day, grinding around the corners, and bumping over irregularities intentionally introduced in the surface of the road. No pavement can stand such battering. Little by little the surface of the road is being worn out, the subgrade is giving way, the pavement is cracking. But all this is part of the plan, and in fact, if any of the 13 sections cannot be destroyed by trucks, the army will be called upon for gun-carriages and tractors to complete the work.

Every Weakness Is Recorded

As the road breaks down, sensitive instruments are recording the origin and development of every cause of failure. Every crack is charted, the effects of changes in temperature and moisture are noted, and the highway engineers are confident that after the test road has been destroyed, a study of these records will show just why and how concrete roads fail. They will know, by scientific experiment, not by guesswork, just how compact a subgrade must be, how thick the concrete roadway should be built, and what the best reenforcement is.

The United States will spend millions of dollars this year in highway improvements. The experiments in California are to insure that a minimum of this money will be wasted, and that the new roads will be built solidly enough to support the heavy trucking and high-speed traffic now found on all our state and national highways.

To make sure that the data obtained by these experiments will be complete, 13 test sections, each representing one of the types of construction at present recommended by highway engineers, are being worked upon. These sections differ considerably in details. The thickness of the concrete varies from five to eight inches, for example. On some sections plain concrete made up with crushed stone and cinders is used, while on other sections have been laid many sorts of reenforcement, varying in character from a layer of chicken wire placed horizontally in the binder, and designed to arrest cracks, to the most elaborate structural steel reenforcements.

Around this quarter-mile concrete track 40 speeding trucks loaded with pig iron grind day and night, 20 racing in each direction. The type of construction that lasts longest will be used for future great American highways

ONE of the great national problems that comes nearest to the everyday life of each of us is the problem of good roads. Millions are wasted annually because of the destruction of poorly built highways, and because of the lack of good roads in rural regions.

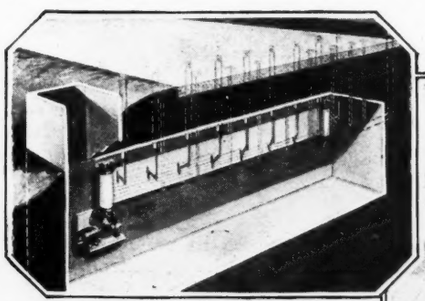
Everybody has watched, at some time or other, the best of pavements gradually breaking up, and has wondered why such damage—universally felt—could not be prevented.

If the remarkably interesting highway-testing experiments described here serve to make the highway of the future strong enough to withstand the battering of modern high-speed and heavy traffic—as the engineers in charge believe they will—every state will reap the benefit in enormous savings and in rural development.

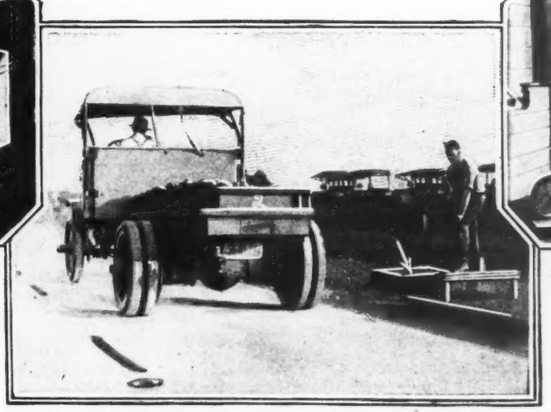
Thanks to four unique observation tunnels built underneath the road, many tests such as have never been attempted before are being made. In these tunnels instruments attached to the under side of the pavement are recording just what happens to the bottom of the slabs and the subgrade when a truck passes above them. In each tunnel nine steel rods, with their upper ends embedded in the concrete, extend downward and operate the recording pens of these instruments; and so trace a complete and permanent record of every movement of the highway and subgrade upon sheets of paper drawn slowly beneath the penpoints by an electric motor. An Ames dial for recording pressure and impact is also installed in connection with each rod.

Trucks Bump Over a Plank

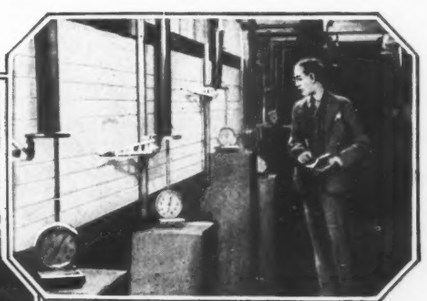
This arrangement is particularly valuable in observing impact tests, which in the past could be recorded only by instruments placed on the surface of the pavement. A plank is placed across the road directly over the tunnel, and the trucks are driven over it at a speed of from 10 to 12 miles an hour. The effect of the impact of the front and rear wheels is recorded on the paper by the pens below, so that a chart of the bending of the concrete slabs and the reaction of the subgrade is visible to the



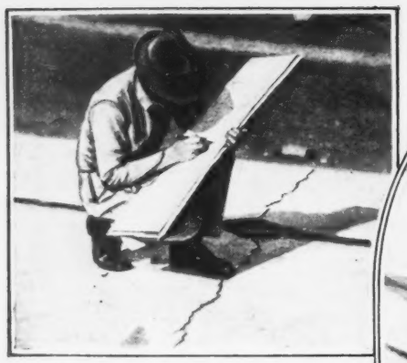
The method of recording movements of the pavement is shown in the above cross section of the track and one of the four observation tunnels. Eight steel rods embedded in the pavement extend down into the tunnel and actuate delicate recording instruments



The boxlike opening at the right, indicated by the arrow, is the entrance to one of the tunnels where road movements are revealed



Here in the interior of the observation tunnel may be seen the steel rods through which every jar on the track above is transmitted to pens and accurately recorded on moving slips of paper. Note also the Ames dials for recording pressure and impact



Charting the progress of a crack as it grows day by day, this engineer is gathering information of vital value to roadbuilders that has never before been studied

Through holes in the surface, borings of the subgrade are taken to determine its precise moisture content

To learn the temperature of any section of pavement, the observer inserts a thermometer into small holes filled with mercury. After the readings these holes are replugged

eye. One result of the Pittsburg tests is the discovery that such blows are much more destructive than has been supposed. A fall of two inches—such as might be caused in actual travel by a small stone in the road—bends the entire concrete road approximately two hundredths of an inch. If such shocks are repeated often, a crack soon develops; and since a fall of half an inch, such as might be caused by a large crack, will bend the roadway nearly a hundredth of an inch, it is apparent why roads rapidly go to pieces once they have started to break, and why prompt repairs are so essential.

History of Cracks Charted

Great pains have been taken to record the cause and development of all surface cracks. The roadway, which is 18 feet wide, has been divided by paint-lines into six-foot squares. A crack is recorded on a chart as soon as it appears, and a progress record is kept. At present little is known about cracking in concrete, or the best means of checking it, and these charts will provide what are probably the first accurate and thoroughly reliable data on the subject.

Another test consists of driving a truck over the tunnel, stopping every few feet, and noting the bending indicated by the instruments. The results have established definitely that a heavy truck, when it is standing still, places more strain on the road than when it is moving; provided, of course, that the surface is smooth and that no jolting or impacts take place. It is possible, in the light of these results, that no attempt will be made to limit the speed of motor-trucks on hard-surfaced highways.

In interpreting these results the temperatures of the atmosphere and the concrete are both important, and a novel method has been adopted to determine the temperature of the road. Holes are drilled here and there in each test-section. One hole reaches to a point near the bottom of the concrete pavement, a second to the center, and a third just below the surface. These holes are coated with plaster of Paris to prevent leakage, and filled with mercury. When an engineer wants to learn the temperature of any section, he inserts the bulb of a thermometer into the mercury, and in about 60 seconds he obtains an accurate reading. After the temperature has been taken, the holes are plugged with corks, and protected from the traffic by metal caps set flush with the surface.

A method somewhat similar has been adopted to determine the effect of water on the subgrade and the rate of percolation. A ditch has been dug on each side of the pavement, so that the subgrade can be flooded until the level of the water in the ditch is on a line with the bottom of the pavement. Before this is done, however, and while the pavement is still perfectly dry, borings are taken from the subgrade through holes left in the concrete. The normal moisture content of the soil when dry is then determined by analysis, and the borings replaced and tamped down.

Bumping over a heavy plank effectively tests road strain. The impact of front and rear wheels, as the truck passes over at 12 miles an hour, is accurately recorded by instruments in a tunnel below

From time to time after the water is turned into the ditches, more sample borings are taken to determine the rate at which the water seeps from the ditch into the soil under the road. These sample borings are made continuously during the road tests.

Meanwhile, observations in the tunnels show the relation between the moisture in the subgrade to the bearing power of the road. This is the first time tests of the kind have ever been made under such ideal conditions, and they are expected to provide data on subsoils and road drainage of great value to contractors. A rain-gage near the track, of course, measures how much natural rain falls during the experiment.

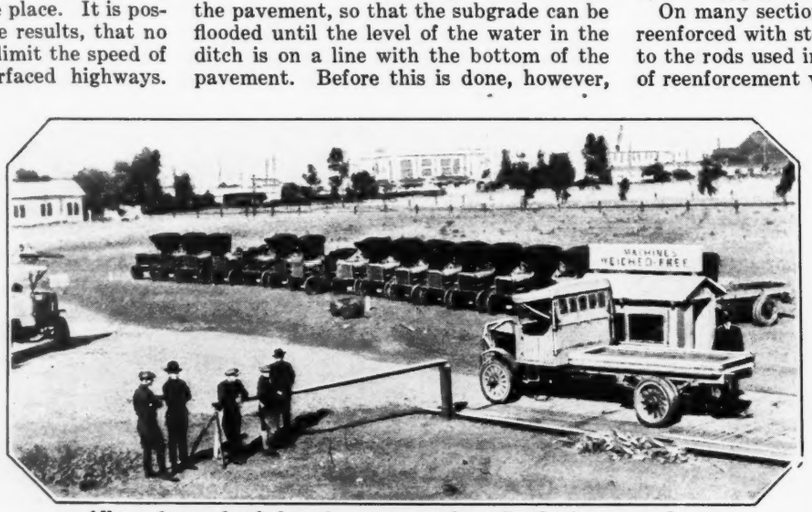
All Trucks Weigh the Same

Another feature of the work is the care with which all trucks are loaded to the same weight to give maximum value to the results of the impact tests. Yet to have all the vehicles of the same type is not considered desirable. The track, therefore, is subjected to the wear of wheels of all sizes, and tires of every type. The trucks are weighed on a 50-ton scale before going on the track, and while standing on the scale each is brought up to required weight by adding pig iron to its load.

On many sections the concrete has been reenforced with steel rods, similar in shape to the rods used in building. The amount of reenforcement varies from 20 to 69 tons of steel a mile.

The truck has been blamed for the rapid deterioration of our state highways. Whether it has been blamed unjustly will be shown by the California tests. If trucks do break down the roads, roads must be built stronger.

By the lessons learned in destroying the test highway, engineers expect to obtain accurate knowledge as a basis for solving the vital national—it may even be called "world wide"—problem of highway construction.



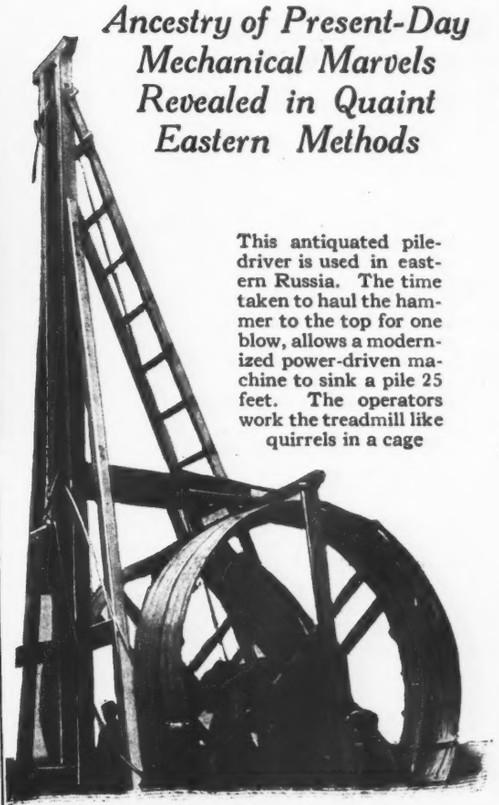
All trucks are loaded to the same weight. In the foreground is an empty truck weighing in on 50-ton scales before taking on its load of pig iron. In the distance are a number of trucks properly loaded with the iron, some of which may be seen piled near the scales

"Granddaddies" of Modern Machines at Work in Orient

Ancestry of Present-Day Mechanical Marvels Revealed in Quaint Eastern Methods

© Ewing Galloway

The hand-and-foot lathe, still used in Syria, is forefather of the automatic wood-copying lathe. By the primitive method shown above a bow-string turns the wood, while a foot-guided file cuts it

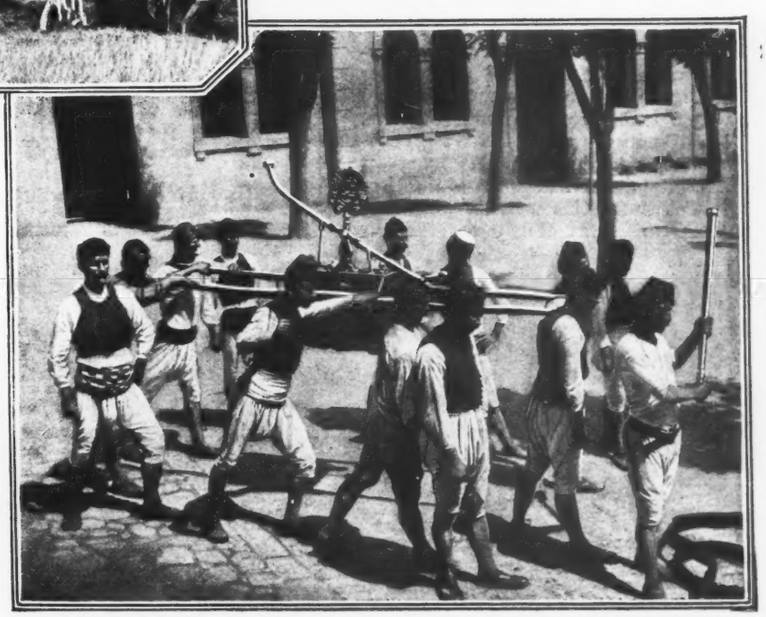


This antiquated pile-driver is used in eastern Russia. The time taken to haul the hammer to the top for one blow, allows a modernized power-driven machine to sink a pile 25 feet. The operators work the treadmill like quirrels in a cage

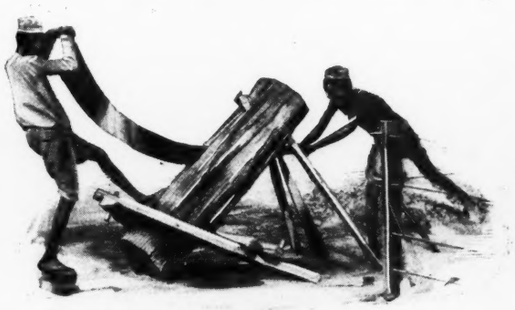
It's a long step from the primitive pumping apparatus, still used by farmers in India, to the centrifugal pump of modern irrigation projects. The Indian walking toward the end of the pole, in the photograph at the left, acts as a counterweight to lift a bucket from the irrigation ditch. The man below dumps the bucket

© Ewing Galloway —

American millers wouldn't smile if they had to work with a crude machine such as the one above. Yet the Chinese miller shows signs of progress, for he has rigged up an extension handle for the turning-pin of his rice-mill



Fire! While high-powered motor-trucks, equipped with motor-driven pumps, roar through the streets of modern cities, husky Turks of old Constantinople's fire brigade continue to carry their fire apparatus on their shoulders



© Ewing Galloway

The machinery in this sawmill consists of a semicircular blade, with a Hindu at each end. From such a process has developed the modern lumber-mill

Government Hunter Ends Career of Wolf Bandit

A LONE wolf that for six years waged a war of terror and destruction among the live stock of southern Montana, where he killed over 150 calves, cattle, horses, and colts worth more than $5000, was shot recently by one of the government's professional hunters who police the Western range country against predatory animals.

This clever wolf lured dogs astray and taught them to attack and destroy domestic stock. When killed, he weighed 82 pounds and was 5 feet 10 inches in length.

Since 1915, Uncle Sam's hunters have bagged 156,150 of the wild animals that prey on the farmer's live stock. This total includes 406 bears, 17,842 bobcats and lynxes, 133,604 coyotes, 668 mountain lions, and 3630 wolves.

Electric Tractor Aids in Cure of Tuberculosis

A LIGHT electric tractor that hauls stretcher carriages about the hospital grounds aids one up-to-date sanitarium in curing patients of tuberculosis by providing enjoyable sun- and air-baths.

The patients, on stretchers, are carried from the wards and placed on a light metal trailer equipped with rubber-tired wheels. Sometimes the tractor hauls three or four of these trailers, and as each trailer carries four stretchers, 12 or 16 patients may receive the benefits of the ride at one time.

Hospital authorities selected the electric tractor for this work because it is noiseless and gives off no fumes.

Camera Fans, Attention!

$500

To readers of POPULAR SCIENCE MONTHLY

SOMEWHERE in your locality is a mechanical or scientific achievement, a new labor-saving or time-saving machine, an ingenious invention or engineering triumph that will interest your fellow readers of POPULAR SCIENCE MONTHLY.

Can You Find It?

PERHAPS, on the other hand, it is an invention of your own—some novelty that you have made at your workbench for convenience around the home, garden, or garage.

Photograph It

and send the picture to POPULAR SCIENCE MONTHLY.

Every month for 10 months POPULAR SCIENCE MONTHLY is going to award prizes to the three readers who contribute the three photographs considered by the editors to be the best and the most interesting to other readers of the magazine. The contest starts now, and first awards will be announced in our April issue.

Any picture with scientific or mechanical interest will be considered, if original and unpublished. Photographs of natural curiosities, scientific phenomena, or of animals or human beings engaged in novel and thrilling activities also may be entered.

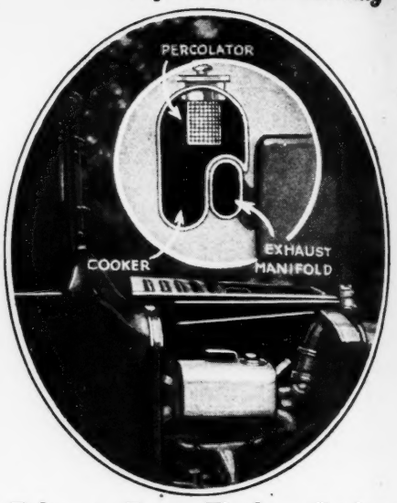
Each photograph submitted for the award must be accompanied by one or more brief paragraphs of explanation.

Three Prizes Monthly

First - - $25
Second - - $15
Third - - $10

Get Films for that Camera

Say It with Photographs



Exhaust Runs Fireless Cooker for Motor Trip

REACHING under the radiator of his auto, he drew out two soft-boiled eggs and a cup of steaming coffee. Really, he did. His name is J. F. Lockhart, of Kansas City, and his invention, which makes hot food possible on tour, consists of a tin container that fits over the exhaust pipe just back of the engine.

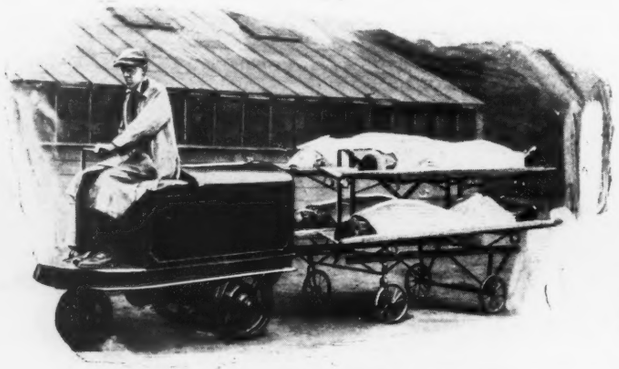
Burning his hand on the exhaust pipe one morning gave him the idea for making hot coffee during cold trips.

Three quarts of boiling water can be produced by driving the car four miles, or by running the engine standing for 15 minutes, says Mr. Lockhart, who is now working on a device for frying steak and making flapjacks as he spins along the Missouri highways.

Daring Motorcyclists Stand on Saddles in Race

HALFWAY down the course, in a recent motorcycle race at Copenhagen, Denmark, the contestants stood upright on the saddles of their motorcycles as they whizzed by at 30 miles an hour. In this manner they rode for nearly 100 yards before finishing the race, which was billed as a "novelty."

This stunt is possible only at a fairly high rate of speed, which makes the motorcycle wheels act as small gyroscopes to keep the machine on a straight course, and only on a perfectly smooth, hard beach without the slightest rut or bump to deflect the front wheels or throw the riders out of balance. Even under the most favorable conditions the feat calls for the utmost skill and nerve.



This is the way patients are carried out to their sun-baths in the modern tuberculosis hospitals

High speed and a smooth course make it possible for the reckless racer to stand on his motorcycle

Hard Work Is Easier at a "Lazy Man's" Desk

FOR the man who prefers to do his work with a minimum amount of effort, Frank B. Gilbreth, a motion-study expert, has invented a "lazy man's" desk, designed to give maximum convenience. Its purpose is to permit the worker to concentrate his full attention on his labors under the most favorable as well as the most comfortable conditions.

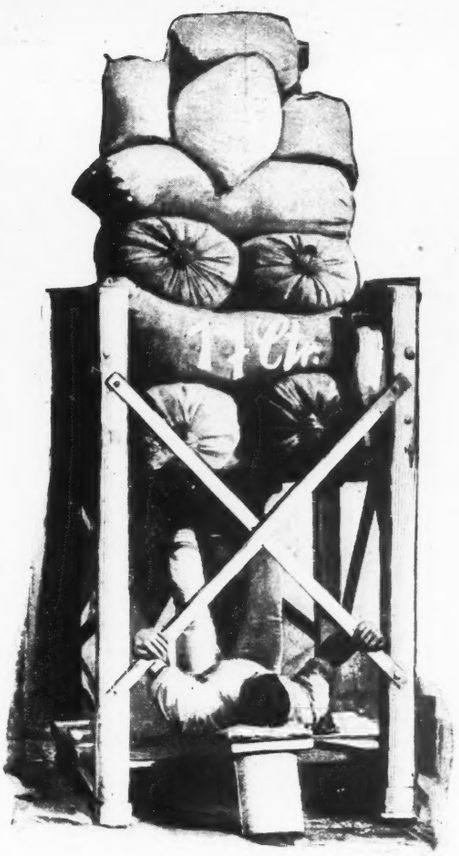
The chair holds its occupant in an erect position, yet it is as soft as padding can make it. The desk is tilted at an angle and the top is adjusted at a distance from the eye that will permit reading and writing with the least possible fatigue.

BY using alcohol derived from sugar wastes in place of gasoline, Cuban taxicab drivers find they make a profit with rates one third lower. They have petitioned the city of Havana to make legal a reduction in fares.

Winds Spread a Cloth of Cloud over Table Mountain

ONE of the famous natural wonders of the world, the great white "tablecloth" that occasionally caps the flat top of Table Mountain, in South Africa, consists of a sheet of dense cloud that forms when warm, moisture-bearing winds are forced up the steep slope. The cloud often pours over the brow of the mountain, like a mighty cataract, and is redissolved as the wind is warmed by compression in descending to a lower level. The rolling mass of vapor sometimes produces beautiful effects that are enhanced by the fact that a clear sky usually prevails while the "tablecloth" overspreads the mountain.

The cloud forms very rapidly. Persons climbing the mountain often are enveloped in it and must either halt for hours or risk serious accidents in attempting to find their way through dense mists.



Baker Hercules, Risking Death, Lifts a Ton of Flour

AT the risk of being crushed, Louis Seidinger, a French amateur athlete, demonstrated the strength of his legs at a recent exhibition by lifting 2400 pounds of flour. Seven men added their weight to the pile before he called "enough." Failure of his muscles would have meant certain death.

Seidinger is a master baker, as well as an athlete. He chose this unusual method of exercise to demonstrate that the weight-lifter relies more on the strength of his legs than on the muscles of his arms or chest. Including the time required to remove the sacks of flour, Seidinger supported a burden varying from a ton to 3000 pounds for nearly five minutes. It was a test of nerve as well as physical endurance.

GRAZING goats over old burned forest areas at Santa Barbara has proved successful in keeping down the underbrush without causing erosion.

Portable Express Office Makes Rounds of Fair Grounds

HANDLING the mass of transactions in connection with shipments of exhibits to the Minnesota State Fair was facilitated recently by a portable express office designed and built at St. Paul. The office traveled from building to building on the fair grounds.

By fitting iron bars into brackets at each side, two men were able to move the office close to the points where freight was piled for shipment.

Collapsible side desks, with drawers for money and supplies, provided a place for the expressman to transact his business. The office was also equipped with electric lights that could be used by attaching wires to sockets in buildings on the fair grounds.

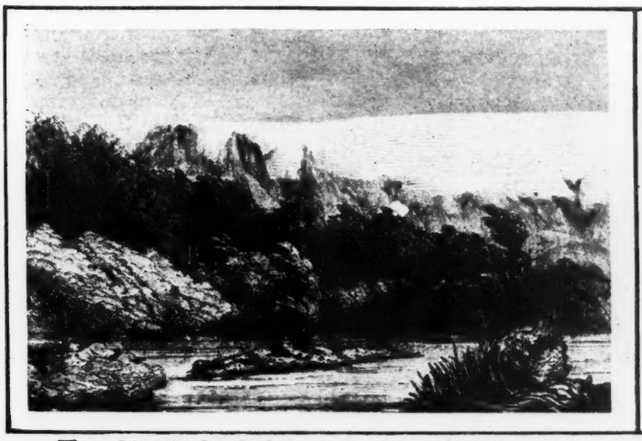
Pigeon-Snaring in the Pyrenees Is a Noisy Sport

GREAT nets, 30 feet high and sometimes extending for a mile across a narrow valley, are used to snare wild pigeons in the Pyrenees. Hundreds of men take part in the hunt.

On high towers on the hilltops are stationed men with guns and flags. Beaters go through the woods and drive a flock of pigeons into the air. When the birds seek to escape, they find their path blocked by noisy sportsmen on platforms above the treetops, shooting guns, waving flags, and throwing bits of wood into the air to frighten them.

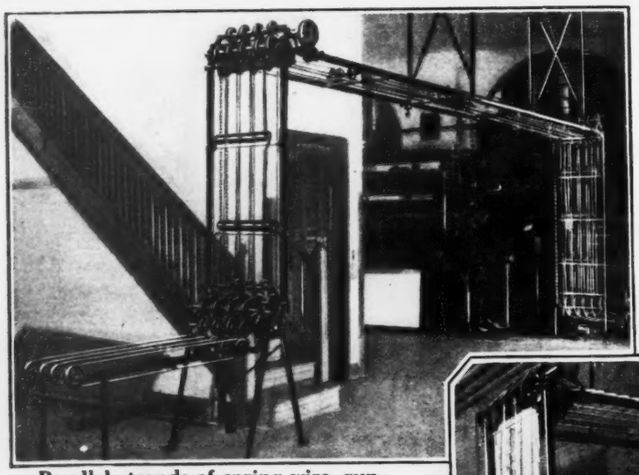
The only avenue of escape for the pigeons is down the valley.

As the birds approach, the nets are suddenly dropped over the entire flock. Sometimes the impact breaks the net cords.



The white "tablecloth" of cloud forms when warm, moist winds are forced up the slope of the mountain

Wild pigeons, driven from the woods and frightened by noises above the treetops, fly into nets 30 feet high



Parallel strands of spring wire, running over pulleys, support and carry the papers

Conveyors Rush Papers from Press to Newsboys

THE speed with which the newspaper publisher rushes your daily paper from the press to you is made possible in one respect and in the most modern plants by an elaborate conveyor system. These conveyors take the papers from the high-speed printing-press and deliver them, folded, to the mailing-room or to the newsboys.

The rapid-transit device can handle either quarter or half fold papers. It consists of a light steel frame, carrying at various points sets of grooved pulleys over which run parallel strands of specially coiled high-grade spring wire. These support and carry the papers, the pulleys being driven by a steel drive-chain throughout the length of the conveyor.

The conveyor is driven by the press and geared so as to advance about three inches for each paper printed. Thus the speed of the conveyor changes with the speed of the press, and papers are spaced the same on the carrier at all speeds. At the completion of the run, the conveyor is cleared of papers by a small auxiliary motor.

When carried vertically, the papers run between two sets of wires and are held by pressure rollers, but on horizontal stretches they lie free on the top of the wires. Any paper may be easily removed for inspection. The wire has a polished surface that does not smudge the fresh ink.

To save time in counting, every twenty-fifth or fiftieth paper is automatically pulled out a few inches.

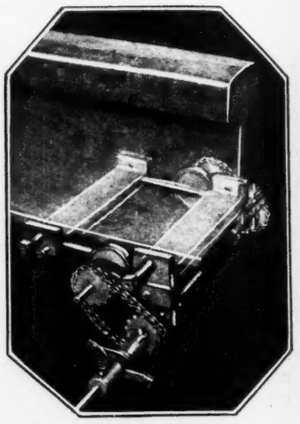
The conveyor is geared to move about three inches for every paper printed

Why Do Rails Break? Eight Sensitive Instruments Tell the Story

WHAT happens to a steel rail when a heavy train speeds over it? Just how does it react to various loads, strains, and shocks? What are the chances of a break that might cause a wreck?

To answer these questions the engineering college of the University of Illinois is conducting a sweeping investigation of railroad rails, rail joints, ties, ballast, and equipment.

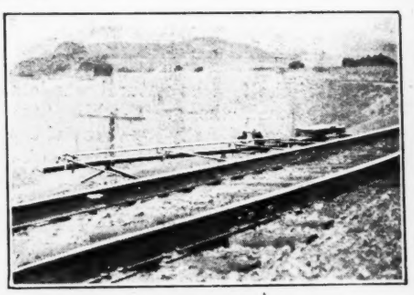
Eight recording instruments are attached to each rail to measure stress, stretch, and compression when a locomotive and train pass over it. Each instrument registers a delicate line on a smoked-glass cylinder by means of a special recording pencil when the rail is subjected to load. The various deviations of this line from a true circle measure strain on the rail. This measurement can be reduced to numerical values by means of engineering tables.



A stremmatograph, attached to a rail, measures the strain under the load of a train

Abnormal stresses as high as 50,000 pounds to the square inch of rail have been located in some rails subjected to unusually heavy traffic. Such strains will deform the rails, with the possibility of serious accidents if they are long continued.

Results from tests of locomotives show that up to a limit of six feet, the closer the wheels are together the better for the rail.



Eight instruments record the strain on each rail when a locomotive and train pass over it

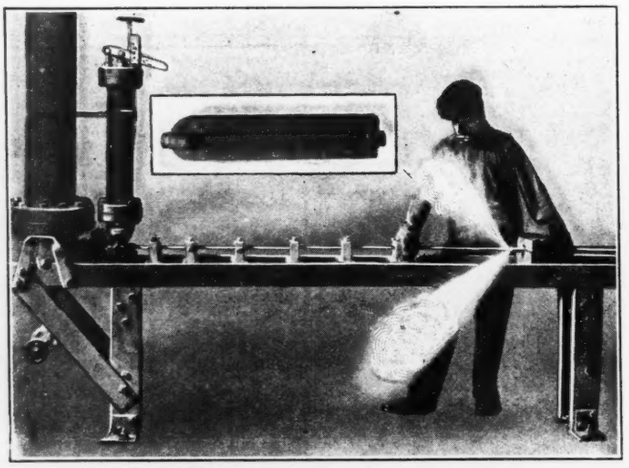
American Process Saves Time in Making Drill Steel

A NEW method of making hollow drill steel by pouring the metal around a steel tube filled with sand, and rolling the entire ingot to the proper diameter, has been evolved by an American firm. The process saves time, and produces an even-graded steel of as high quality as the best drill rod made in Europe.

Instead of drilling a hole through a solid billet, as is done in England, or rolling the billet over a projectile or ball, as in pipe making, which is the Swedish practice, the American method casts the ingot around a thin steel tube filled with sand. The hot metal welds itself to the tube in the mold so perfectly that it is usually impossible to find the junction.

The tube is made of steel having a melting-point slightly higher than the casting metal. It is filled with sand, plugged with steel stoppers, and centered in an ingot mold. Then the metal is poured through four small nozzles down the corners of the mold. If the tube has been properly cleaned by sand blast, an excellent weld results. The fact that the tube has a higher melting-point than the steel of the cast prevents the tube walls from burning through.

The sand is left in the ingot after casting, as this core is useful in rolling the ingot down to size. After forging, the sand is blown out by compressed air. This is done in the following manner: A thin tube is inserted in the hollow drill bar. Through this tube passes a mixture of sand and air supplied from an air-pressure chamber and a smaller chamber containing fine sand. The blast blows the sand from the core, and at the same time exerts a cleaning and polishing action on the inside of the drill rod. As the sand is blown away, the air-tube is thrust further into the opening. By this process a hollow steel bar 20 feet long can be cleaned of sand in less than a minute. Because the sand and the small tube move in the same direction, the blast does not wear away the feeding-tube to any appreciable extent.



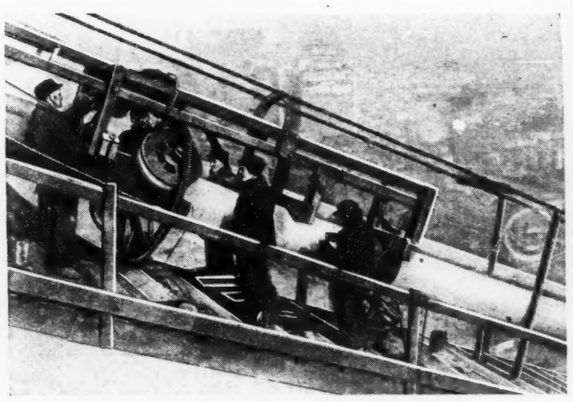
A powerful sand blast cleans the thin steel tube around which the ingot is cast

Williamsburg Bridge Cables Dressed in New Suit of Wires

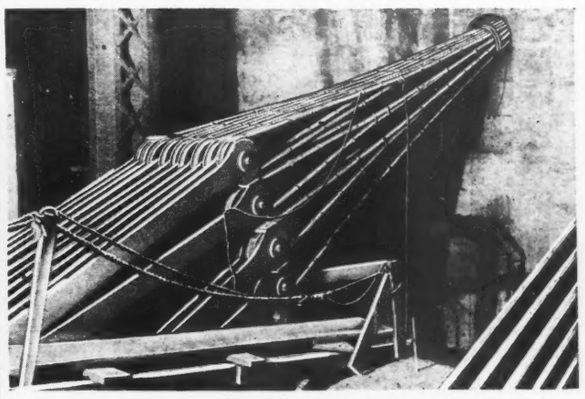
Before the four weatherbeaten cables of the Williamsburg Bridge over the East River could be wrapped with wire for protection from rust, it was necessary to build a 2800-foot stairway scaffold along the entire length of each cable

The picture at the right shows workmen squeezing up the cable wires preparatory to wrapping them. Nine thousand parallel wires in each cable were put under 15 tons pressure before they were wound with outer wire

Photographs © American Photo Service

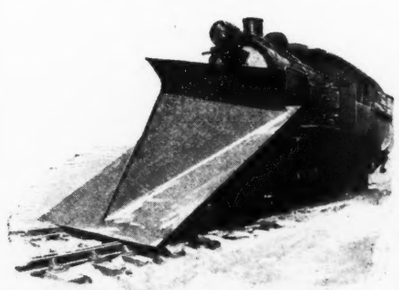


An electric winding machine was used to bind the cables with soft steel wire an eighth of an inch in diameter and 970 miles long



This photograph of one of the eight bridge anchors shows the manner in which the cables are attached to the concrete abutments

Detachable Snow-Plow Clears the Track Quickly



FOR snow of moderate depth this simple snow-plow is said to be as efficient as any form that can be devised, and it has the outstanding advantage that it can be attached to any engine in a very few minutes. The upper end is held to the engine frame with toggle bolts; the lower end slides over the track, and chains or bolts fastened to the cowcatcher prevent the plow from being twisted to either side.

The equipment has been adopted by an Eastern railroad. The plows are comparatively cheap, and one has been provided for every engine, so that plowing begins at many points on the line as soon as snow starts to fall. As the tracks are cleared after the passage of every train, the snow has no opportunity to bank up on the tracks nor to drift to such a depth that it cannot be removed by plows of this type.

ZINC oxide will absorb all the ultra-violet radiations produced by an electric arc-welding machine. If the room is painted with this material, nothing but harmless visible light will be reflected back. As pure white would be too dazzling, the paint should be toned down to a light gray by the addition of lampblack and mixed to produce a dead surface, which would reflect only light free from dazzling glare.

Four Men and Machine Do Work of Fifty

DIGGING the holes by an earth-auger and setting the telegraph-poles in place with its own crane, this motor-truck and its crew of four can set fifty poles in one working day—as many as a crew of fifty men.

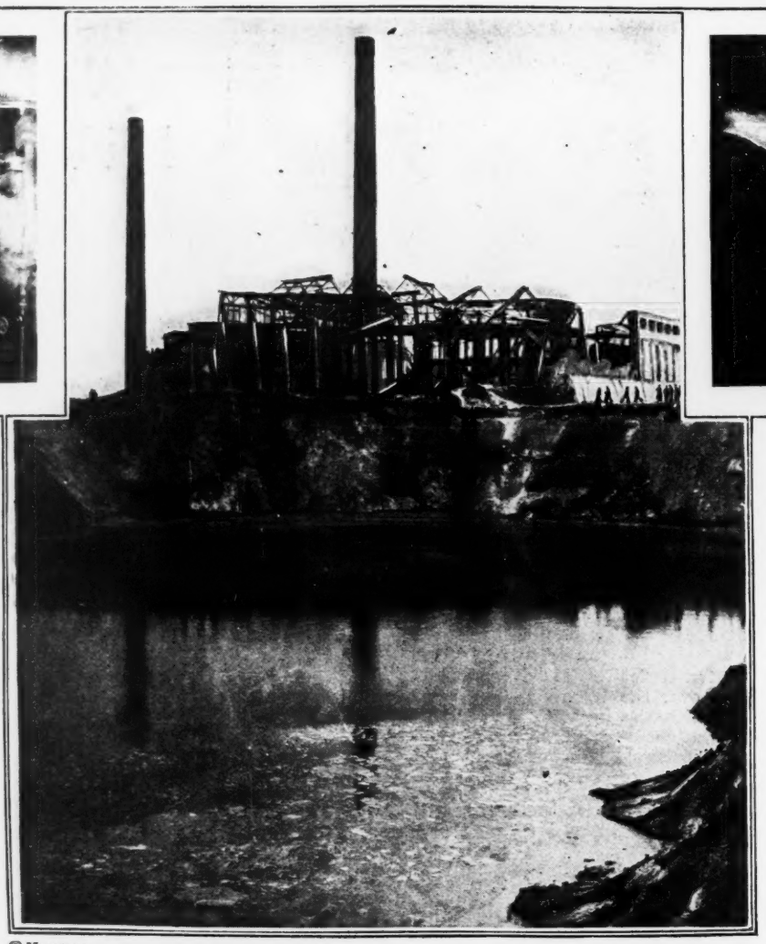
In ordinary soil the auger will excavate a pole hole in three minutes. The derrick holds the pole vertically, ready to drop into place, and the men simply shovel back the earth and tamp it down.

Army Gas-Mask to the Rescue

AN old army gas-mask proved that it had not outlived its usefulness when a pipe, carrying liquid sulphur dioxide into an experimental pulp-digester, sprung a leak in the Forest Products Laboratory at Madison, Wisconsin.

Clouds of acrid smoke drove all workers from the building. Without protection from the fumes, it would have been impossible to enter the room where the leak occurred until the gas was all exhausted and the building aired. But with the aid of the army mask, plumbers were able to shut off the gas and repair the leak in less than an hour.

If the fumes had been of ammonia or carbon monoxide, the mask would have been useless.

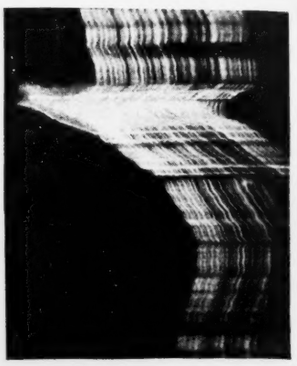


© Keystone

Tall Chimneys Stand Unscathed above Oppau Ruins

WITHIN a stone's throw of the huge crater that marks the site of the disastrous explosion in the Badische Chemical Works at Oppau, Germany, stand two tall chimneys, shown in the illustration, unharmed by the force of the blast. How these stacks escaped destruction while whole factory buildings were demolished around them, is one of the mysteries of the disaster that remain unsolved.

Whatever caused it, the explosion was powerful enough to blow a hole 300 feet wide and 40 feet deep in the stony soil.



Many Flashes in Lightning Bolt

THAT a lightning flash may be made up of half a hundred discharges following one path within half a second, has been proved by the use of a revolving camera focussed on the heavens and turned from side to side by clockwork during a storm.

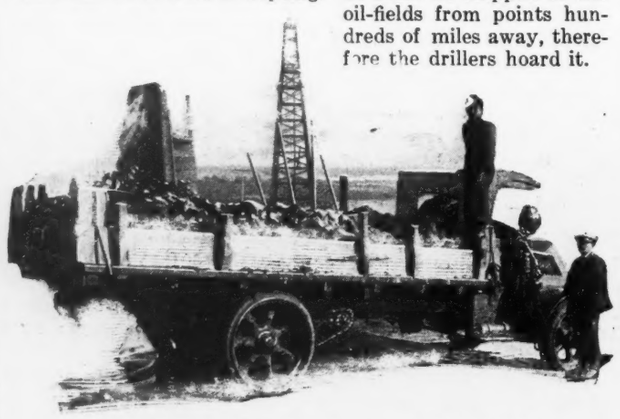
The part of the flash shown in the picture above was about a mile and a quarter in length. To the naked eye it looked like a single, flickering bolt, but the moving photographic plate, operated by a Weather Bureau expert in Washington, registered about 40 separate streaks, which caused the flickering appearance.

The camera is not a moving-picture apparatus, but employs a single plate and an ordinary shutter.

Mud Is Precious as Gold in Oil-Fields

IF a small piece of mud falls from a truck in the Montebello oil-fields of southern California, the driver stops, picks up every tiny piece, and throws it back on his load. Because the native soil is sandy, mud is so precious there that it cannot be bought. It is loaned, with the understanding that it will be returned immediately.

The mud is absolutely necessary in drilling for oil, for it is used as a primer to start the rotary drill, and is driven into the hole under steam pressure, as the drill penetrates, to prevent the walls from collapsing. It must be shipped to the oil-fields from points hundreds of miles away, therefore the drillers hoard it.



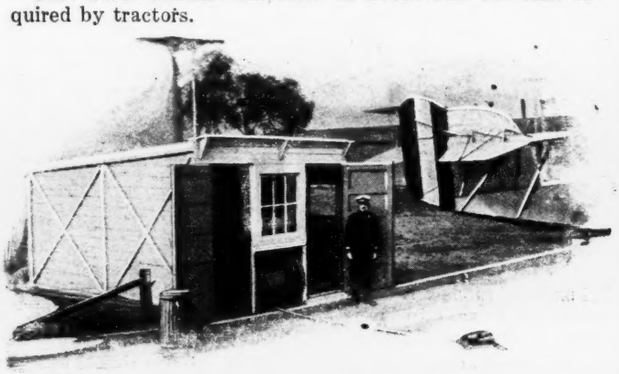
If mud falls overboard on its way to the oil-fields, the driver stops and picks it up

Winch Hauls Seaplanes into Their Hangars

ONE electric winch has replaced several tractors formerly used to haul seaplanes ashore and into their hangars at the North Field air station in California. A steel cable is led from the winch to the landing-beach by snatch-blocks hooked to rings embedded in the concrete roads.

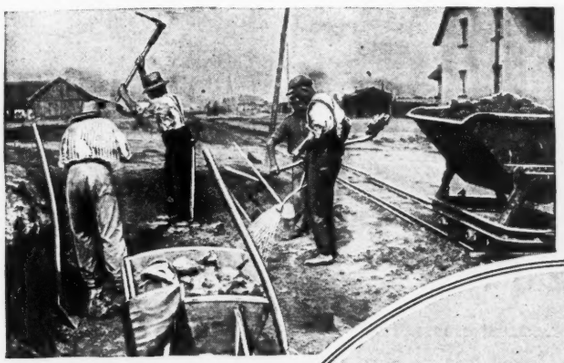
When a seaplane lands in the bay, it "taxis" near the shore and while still in the water, a wheeled cradle is pushed under the hull. The cable is then attached to the cradle. A few turns of the winch haul the seaplane ashore. After the cable has been hooked over a pulley in the rear of the hangar, a few more turns send the plane home.

This winch handles seaplanes in about half the time required by tractors.

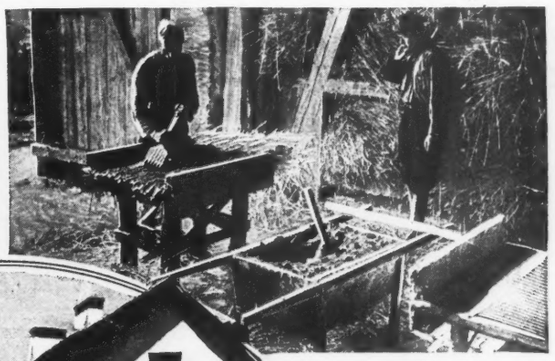


Cables leading through anchor blocks and then to motor-driven winches, haul seaplanes in any direction

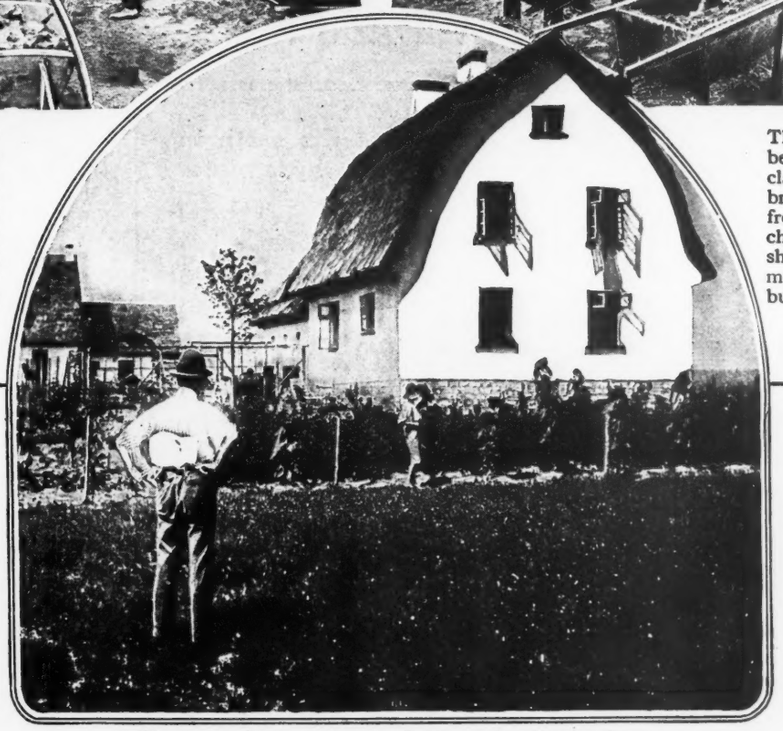
Needy Germans Build Houses of Mud and Straw



The clay required for building a typical mud-and-straw house is dug out of a clay bank and is sprinkled with water to cause it to form lumps that are easier for workmen to handle than fine dust



The straw which is to be mixed with the clay mud to form bricks is first freed from roots; then it is chopped up into short lengths by means of the simple but effective machine pictured above

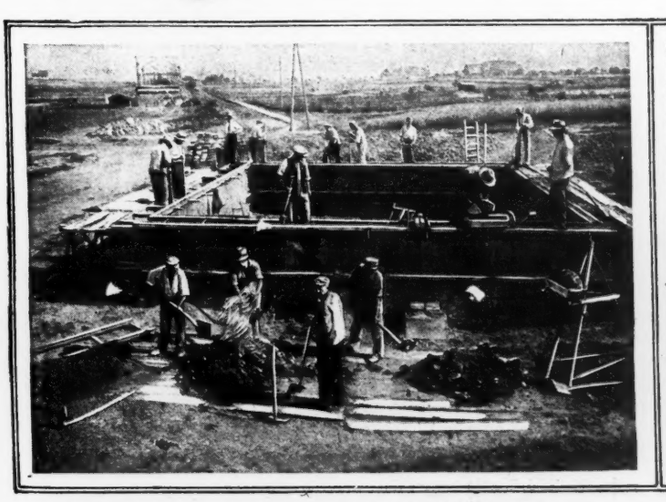


The attractive appearance of this mud-and-straw house, recently completed in Germany, suggests the possibility that the use of this material may stimulate and even revolutionize building operations in many impoverished areas. Mud-straw is cheaper than nearly every other form of building material

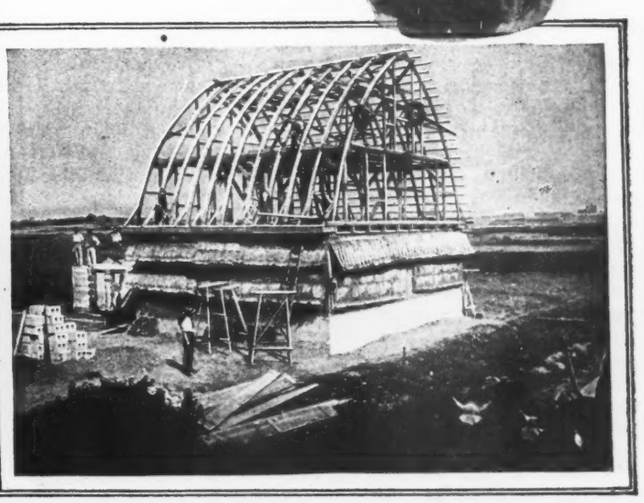
The picture at the left shows a workman carrying one of the mud-straw bricks, which are seen to be much larger than the burned bricks commonly used

The method of erecting the walls of the house on a concrete foundation is illustrated below. The mud-straw bricks are placed in rows and cemented with soft mud

Photos © K. & H.



Above is pictured another method of building houses from mud-straw. Soft mud is mixed with straw and dumped into molds like concrete. Then it is stamped down, while it is still wet, to make it compact



The photograph above shows the structural detail of the roof, as well as the method of protecting the mud walls from the rain by thatched curtains until they have become dry enough to be waterproofed

What Do You Want to Know ?

Let Popular Science Monthly Answer Your Problems

Answers to Knotty Questions Will Add to Your Store of Knowledge

What is the black substance found inside incandescent-lamp bulbs after they have burned for some time?—E. L. A.

The black substance is finely divided tungsten that has been volatilized by the heat in the filament. The lamp manufacturers have experimented with inert gases placed inside the bulb with the idea of limiting this volatilization.

If a stick of wood is placed in a tank of water, the tank will not be ruptured when the water freezes. Why is this?—A. F.

When water freezes it expands and tends to occupy a greater space than it occupied as a liquid. In doing this it presses against the sides of the tank, which resists the expansion. But the force of freezing water is irresistible, and unless the force of expansion is taken up in some other way, the tank will be broken apart. A stick of wood in the water is compressed by the expansive force of the ice, thus relieving the tank of the pressure.

How many molecules are there in gases and how are they counted?—W. R. T.

The number of molecules varies with the pressure and temperature, but at atmospheric pressure and at 0°C. it has been found that gases contain about 434 million million million molecules to the cubic inch. This figure is obtained by measuring the electric charge of an atom and finding the coulombs of electricity transmitted when a certain volume of the gas is electrolyzed.

Please give me a formula for a low melting alloy.—G. R. C.

An alloy that melts at 202°F.—lower than the boiling temperature of water—can be made from 8 parts of bismuth, 5 parts of lead, and 3 parts of tin.

What makes the color of a yellow object yellow and of a red object red?—L. R.

Color is due to the selective absorption and reflection of a substance. The material absorbs some rays and reflects others, but only the reflected rays affect the eye. The exact reason why a substance shows a preference for one color over another is not yet definitely known. One theory is that the molecular structure determines what colors are permitted to pass into and be absorbed by the substance, thus leaving the remaining rays to be reflected. An excellent treatise on this subject is contained in a "Handbook on the Theory of Color," by C. H. Hurst.

If the sun is closer to the earth in winter than in summer, why is winter colder?—R. S.

THE difference in seasons is not due to the relatively small change in the distance between sun and earth, but to the variation in the slope of the earth as it travels its orbit. In summer the earth is tilted so that the northern hemisphere is almost perpendicular to the sun's rays, while in winter the same territory has altered its position and the rays strike it at an oblique angle.

Does the liquid taken from trees to make rubber affect the growth of the trees?

No. The substance used to make rubber is not the sap of the rubber plant, but is a milky juice called "latex," which is found in the outer bark of the trees and is not directly connected with the nutritive system of the trees. The exact function of latex is not known.

At a given temperature will ice freeze thicker at the North Pole than in the temperate zones?—F. V. E.

All conditions being identical, ice will freeze to the same thickness under a given temperature. The direction and force of the wind, and the comparative depths of the bodies of water are conditions that directly determine the thickness of ice.

What Is Your Question ?

Every reasonable specific query in the field of general science addressed to this department will receive a prompt reply. Legal and medical queries cannot be answered.

A stamped self-addressed envelope must accompany each question, but the writer's name will not be published, if he so requests.

Address the Editor, Popular Science Monthly, 225 West 39th Street, New York.

What system do the Chinese use on their abacus?—O. H.

The Chinese use the decimal system on their abacus or "sun pan." This primitive device consists of sliding beads that have the value of units, tens, hundreds, thousands, etc. The wires running across the frame of the abacus and on which the beads slide are divided in the middle by a strip of wood. On one side of the strip only two beads or "counters" are threaded. These represent the higher unit. On the other side four or five counters are threaded, representing the lower order of units. When the number to be indicated is more than five, one of the two counters is moved to the center and as many more of the other counters are moved to the center as are necessary to make up the balance. For example, in representing the number 7, one of the two counters would be moved to the center and two of the others moved toward the middle strip, thus making a total of "five" plus "two," equaling seven.

How is papier-mâché made?—J. I. K.

Papier-mâché is made by mixing finely ground paper with water and kneading until the material is in paste form. It is then placed in the molds and later dried in ovens. A finer sort of papier-mâché article is made by pasting together whole sheets of paper of a particular kind and laying them over a mold to which heavy pressure is applied. Ceramic papier-mâché is made from a formula requiring paper pulp, resin, glue, potash, china clay, and other ingredients.

I have a Cooper-Hewitt mercury-vapor lamp for direct current, but would like to convert it for use on alternating current. Is this possible?—L. B.

It is possible, but not desirable. Such a change requires the purchase of considerable auxiliary equipment. You will find it best to sell your present lamp and purchase a new one suitable for your conditions.

What place in the United States has the lowest relative humidity?—S. P. C.

According to the records of the Weather Bureau, the lowest is found in some parts of Arizona, although it is possible that certain sections of the deserts in southern California, where there are no recording stations, may show lower relative humidities than Arizona.

New Alphabet Brings Machinery into Chinese Printing-Shops

CHINA, reputed to be the birthplace of printing, is at last substituting modern type-setting machinery for laborious hand methods employed for thousands of years. The introduction of the speedy linotype machine, such as is used in American newspaper plants, was made possible not long ago when the young Chinese republic approved a phonetic alphabet, which reduces the number of characters or symbols of the language from many thousands to thirty-nine. This alphabet was evolved by Chinese scholars after forty years of study.

The new phonetic symbols are without meaning in themselves, but are grouped together to form words. In appearance, they resemble the old characters, each of which stands for a separate word.

With a language consisting of thousands of different characters, machine composition was impossible, but with thirty-nine symbols it is easy to compose Chinese on linotype machines that differ from the American machine only in the style of the keyboard.

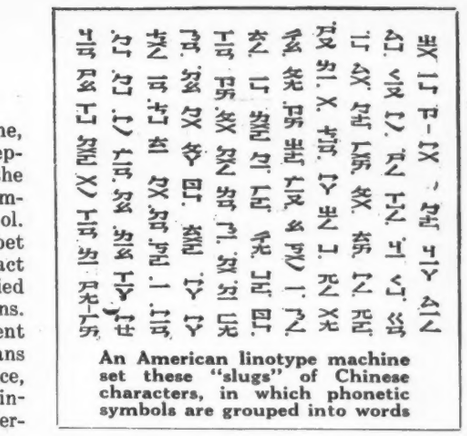
Printers Walk Miles

The old Chinese method of printing, which still survives, is this: A sheet of soft paper is laid on a wooden plate on which characters have been cut and inked by hand with a brush. Impressions are made by rubbing the paper with a stiff brush of split bamboo. In more modern Chinese printing establishments, separate metal type is used; but because each word is represented by a distinct character, thousands of pieces of type are required. A compositor must trudge for miles, from one type-case to another, to find the type he needs in setting a single page.

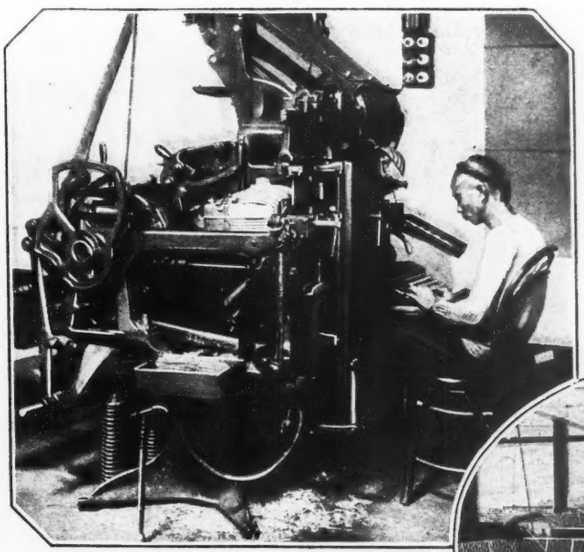
In the new phonetic alphabet, as adapted to the modern composing machine, one half of all the Chinese words can be represented by the combination of two of the thirty-nine symbols, a few by three symbols, and the remainder by a single symbol.

The task of creating the new alphabet was extremely difficult because of the fact that Chinese word sounds are multiplied by a variety of inflections or intonations. One sound may have several different meanings. "Chi," for example, means "chicken" if uttered in a level tone of voice, or "excited" if spoken with a rising inflection. There are over a hundred different meanings for the monosyllable "shih," either alone or in combination with other ideographs. In contrast with this, the new symbols indicate not only the meaning, but the pronunciation of words.

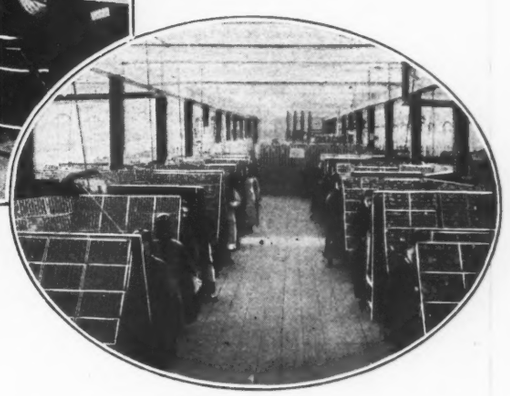
The phonetic alphabet is now being taught in the schools of China, while the linotype is bringing it into use in newspapers and other publications. The simplification of writing and printing is expected to become a powerful aid to China's progress.



An American linotype machine set these "slugs" of Chinese characters, in which phonetic symbols are grouped into words

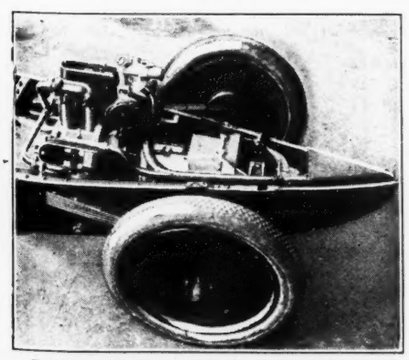


Heretofore, 40,000 type units were required to completely equip Chinese printing establishments, and the business of setting type was painfully slow. Now Chinese can be composed quickly on a linotype machine adapted to a new phonetic alphabet of thirty-nine symbols



Automobile Shaped Like Falling Raindrop Uses Little Power

BY designing an automobile in the shape of a falling raindrop, Rumpler, an aircraft manufacturer of Germany, has evolved a model that will make high speed with a very small engine. The body is streamlined throughout to produce a car with the smallest practicable head-on resistance to air pressure. The raindrop shape was chosen because a falling drop of water assumes a perfect streamline form in its passage from the clouds to the earth. Even the mudguards of the car are made flat and straight, like an airplane's wings, to reduce resistance, and the under part of the car has a streamlined bottom of thin metal.



The engine and gear-box are over the rear axle, making a universal joint unnecessary

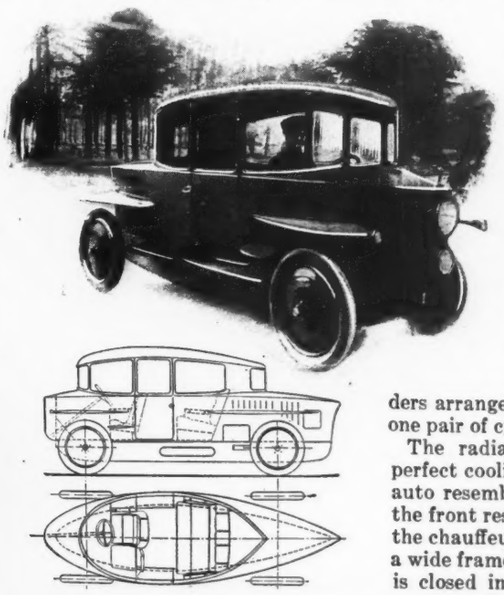


Photo and drawings show the odd body design and seating arrangements

In carrying out his idea, the inventor has made what are said to be many improvements in conventional design. For example, the motor and transmission form a unit that is mounted to swing about the rear axle, thus doing away with the propeller shaft and universal joints, and forming a compact power plant. The motor is of small horsepower with its six cylinders arranged in pairs. It is of the Y type, having one pair of cylinders vertical in the center.

The radiator is behind the motor and gives perfect cooling by means of a fan. The back of the auto resembles the front of an ordinary car, while the front resembles an airship car and has a seat for the chauffeur in the bow. The chassis is made up of a wide frame of pressed steel shaped like a boat, and is closed in and streamlined on the bottom. On account of the reduced resistance, cars of this type of but nine brake horsepower have made 75 miles an hour recently in races on a track near Berlin.

Twenty Automatic Machines Relay Radiogram

1
The wireless telegram is handed in at the office
2 Quickly translated into Morse on the perforating machine
3 Issues in the form of perforated tape
4 Sent to the wireless station on the Wheatstone transmitter
5 Received at the station on the Creed receiver
Thermionic valve
Nickel electrode
7 The transmitter with its bank of thermionic valves
8
Aerials
The great steam-electric generators supply the necessary current to the transmitters

© Modern Publishing Co.

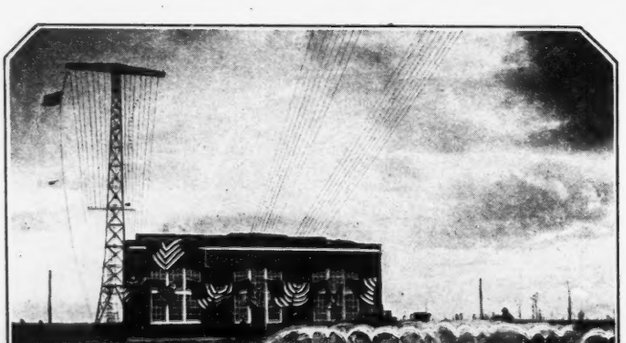
The one-minute history of the radiogram, from the time it is filed in London until it reaches the hands of a messenger in New York, is graphically told above. On its quick journey the message passes through a score of instruments

By P. J. Risdon,

English Correspondent of the "Popular Science Monthly"

BY means of the latest automatic radio apparatus a radiogram from London to New York can be delivered in just 60 seconds. One minute after the message is filed in the London office, the printed radiogram is placed in the hands of the messenger-boy in New York. In that time the message has been telegraphed to the transmitting station, turned into Morse and broadcasted, received at the Riverhead, L. I., station of the Radio Corporation of America, relayed to New York, and printed.

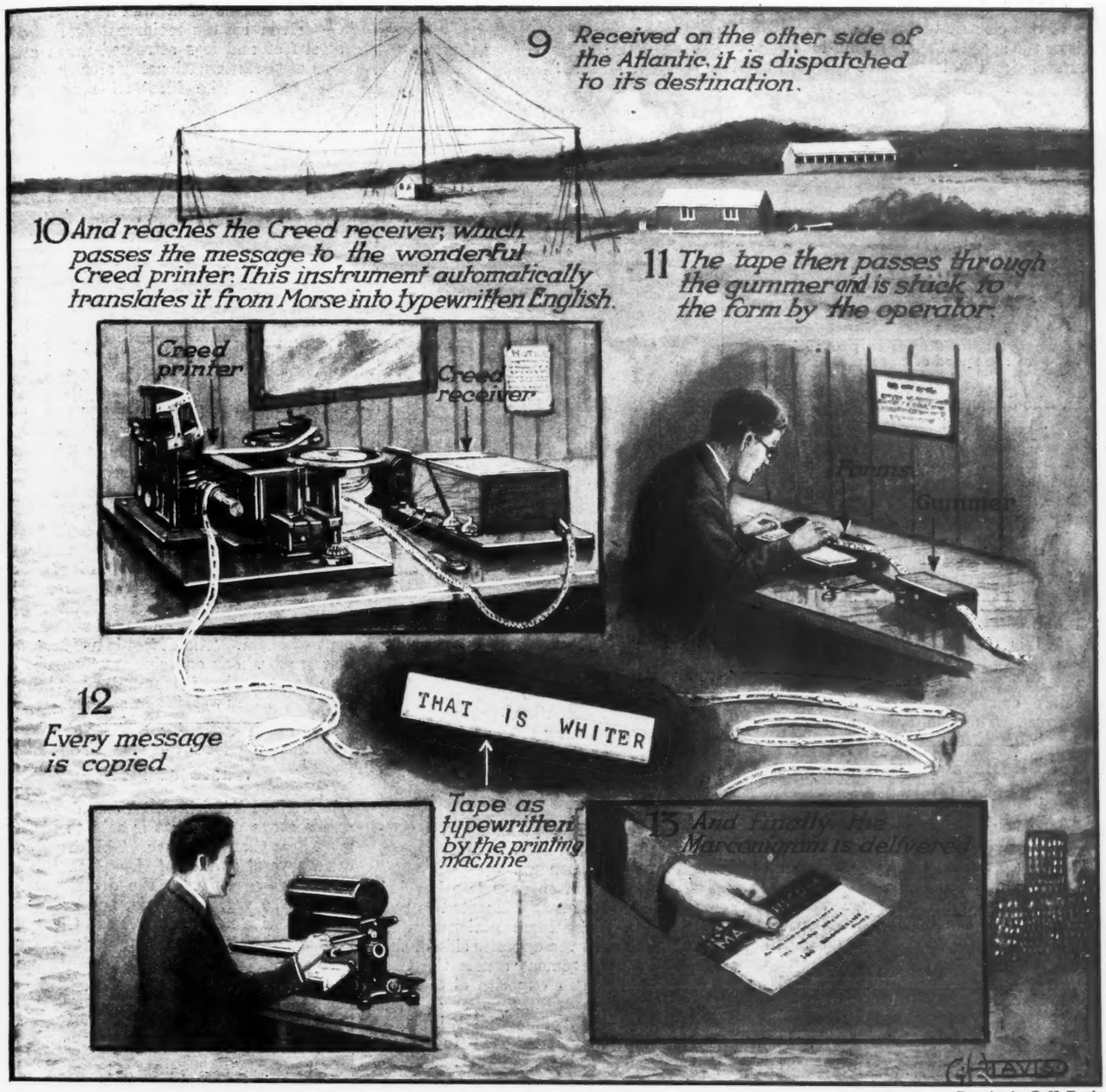
This speed, made possible by the aid of up-to-the-minute machinery, is the more remarkable because the message passes through nearly 20 instruments. It is relayed from one electric current to another about 12 times, but only three times is it handled by human operators. If they could be eliminated, even more speed could be attained.



The nerve center of the great system is the Radio Central Station at Rocky Point, Long Island. Here a 23,000-volt current is transformed into high-frequency Hertzian waves that can carry messages halfway around the world

When the radiogram is handed to the operator in London, he types it on a special machine that perforates a paper tape with holes representing the Morse code, corresponding to the words of the message. This tape passes through a Wheatstone transmitter, which sends it to the radio station over ordinary land telegraph wires. At the station, this current actuates another ingenious mechanism that punches another tape, duplicating the first. The second tape immediately passes

From London to New York in Sixty Seconds


9 Received on the other side of the Atlantic, it is dispatched to its destination.
10 And reaches the Creed receiver, which passes the message to the wonderful Creed printer. This instrument automatically translates it from Morse into typewritten English.
11 The tape then passes through the gummer and is stuck to the form by the operator.
Creed printer
Creed receiver
Forms
Gummer
12 Every message is copied
THAT IS WHITER
Tape as typewritten by the printing machine
13 And finally the Marconigram is delivered
G. H. DAVIS

Drawing by G. H. Davis

Although the message is relayed a dozen times, only three times is it handled by human operators. Flashing across the Atlantic, it is received at the Radio Corporation's Long Island station and relayed to New York for delivery

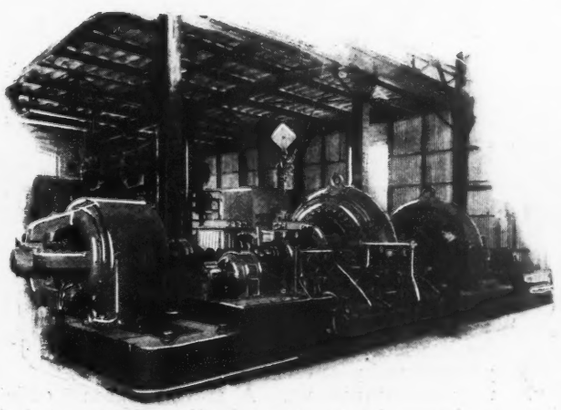
under a second automatic transmitter, which broadcasts a radio message, utilizing great electric generators and banks of thermionic valves to build up a current of the requisite power and high frequency. So far, under ideal conditions, perhaps about 20 seconds have elapsed.

With the speed of light, the message leaps the Atlantic, and is caught by the antennae of the great radio station at Riverhead. Here miles of antennae wires, supported by cross arms 150 feet wide, placed on the top of 12 towers 410 feet high, gather the feeble impulses, and build them up with a second bank of thermionic valves until the current becomes strong enough to operate a Creed printer.

It is the Creed printer—the heart of the whole system—that makes possible the remarkable speed of transmission. By a system of magnetic controls guiding a pneumatically operated typewriter, it transcribes the long and short dots and dashes received by the antennae into a typewritten message printed on a long strip of paper tape.

This paper tape is gummed, torn into suitable lengths, and pasted on a blank. The message is copied by an operator, who passes it to the district messenger-boy. The Creed machine is located, not at the receiving station, but 16 miles away, in the heart of New York City.

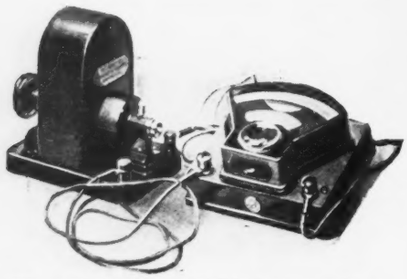
To obtain the advantages of a central office, however, both receiving and sending stations are operated from a central "traffic" office by the use of a special remote control system.



In the Long Island power plant direct current is turned into alternating current by high-frequency alternators, which produce a current of 20,000 cycles. The speed of the great motors is controlled with wonderful accuracy

Portable Electrical Tachometer Driven by Belt

A SMALL dynamo is used as the basis of this electric tachometer, which will register the speed of shaft revolutions very accurately, and which may be operated by



The voltage generated is in proportion to the speed of the shaft

a man who does not possess a knowledge of electrical machinery.

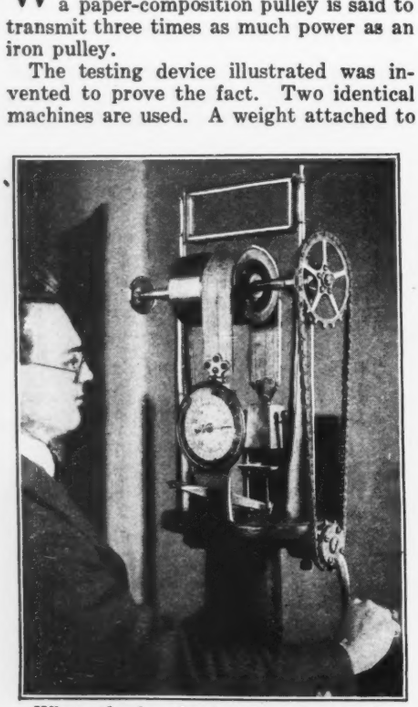
The dynamo is driven by a belt passing over the shaft the speed of which is to be measured. The little electric generator is so constructed that the voltage will be directly proportional to the shaft speed, and if the current it produces is led through a specially calibrated voltmeter, the speed can be read directly off the scale.

A GEORGIA farmer, John L. Cliett, has succeeded in growing forty-nine varieties of crops, including cotton, peanuts, and tobacco, on a farm in Prosser, Washington, heretofore considered too far north for these crops. The quality is excellent.

Paper Pulleys Transmit More Power than Iron

WITH the same belt and pulley speeds, a paper-composition pulley is said to transmit three times as much power as an iron pulley.

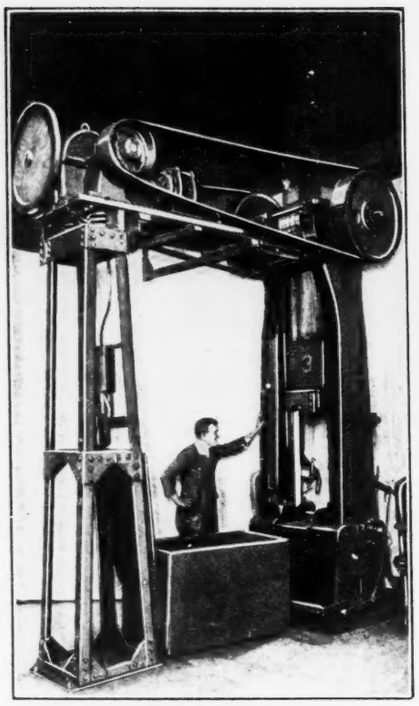
The testing device illustrated was invented to prove the fact. Two identical machines are used. A weight attached to



When the hand wheel is turned, the dial measures the pulley friction

a spring balance is hung over the pulley, and by turning the hand-wheel the driving power produced is measured on the dial.

With the ordinary pulley the dial registers three pounds. With the composition pulley the force exerted is nine pounds.

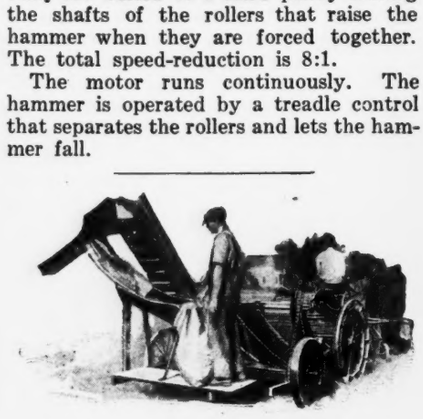


Motor-Driven Drop-Hammers Used in Large Factories

THE individual motor-drive has been applied recently to board drop-hammers in large industrial plants. The hammers range from 300 to 2500 pounds in weight. Each installation consists of two towers, one containing the hammer mechanism proper, while the other supports a 15-horsepower, 800-revolutions a minute induction motor, directly coupled to a shaft carrying one loose and one keyed pinion, with a flywheel at the extreme end to take the initial peak load off the motor when the hammer is drawn up.

The keyed pinion engages two beveled gears, which are directly connected to two pulley-wheels. The loose pinion simply acts as a spacer on the opposite side of the gears. This arrangement causes the two pulleys to revolve in opposite directions. They are belted to a third pulley driving the shafts of the rollers that raise the hammer when they are forced together. The total speed-reduction is 8:1.

The motor runs continuously. The hammer is operated by a treadle control that separates the rollers and lets the hammer fall.

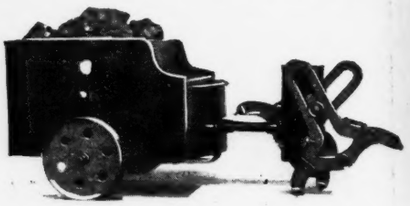


Machine Handles Potatoes from Ground to the Sack

USED in connection with a digging machine, this attachment cleans the potatoes and puts them in sacks as fast as they are turned up. A moving apron equipped with wormers rolls the potatoes to one side as it revolves, and carries the vines and weeds over the top. An elevator then lifts the potatoes to the chute at the left, from which they roll or fall into sacks.

Automobile Walks on Steel Feet over Rough Ground

TOY models of a walking automobile driven by the reciprocating action of steel feet and legs attracted much attention at the International Motor Exposition at Prague. The illustration shows the walking drive to be simple in principle.



The circular motion of the driving crank is converted into leg action

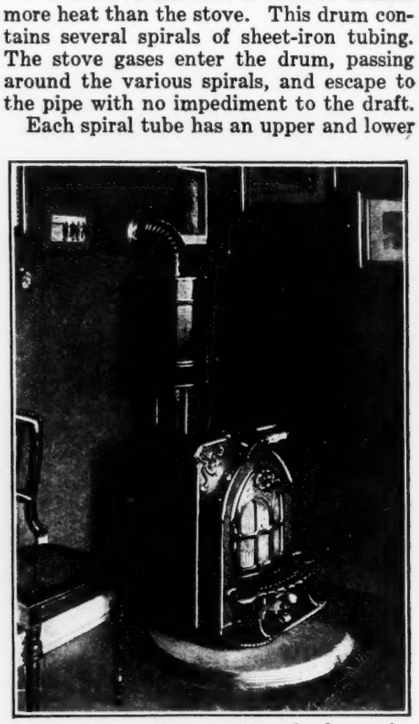
The circular motion of the driving-crank is converted into a perfectly uniform horizontal motion of the mechanical feet. The wear and tear on the main parts of the mechanism is virtually nil, and the treads and guide-rolls may be readily replaced. The capacity of the drive is considerable and the fuel consumption low.

Its inventor claims that over rough ground the walking drive is more efficient than the caterpillar truck. This is debatable, even if a wheel or caterpillar must surmount all obstacles on the ground, while a walking-truck need only deal with 20 per cent of them. The device is not intended to replace wheels on vehicles traveling over smooth roads, but it is said to be an advantage to tractors working in soft soil.

Drum on Stove-Pipe Prevents Waste of Heat

A EUROPEAN inventor has developed a stove drum that is said to radiate more heat than the stove. This drum contains several spirals of sheet-iron tubing. The stove gases enter the drum, passing around the various spirals, and escape to the pipe with no impediment to the draft.

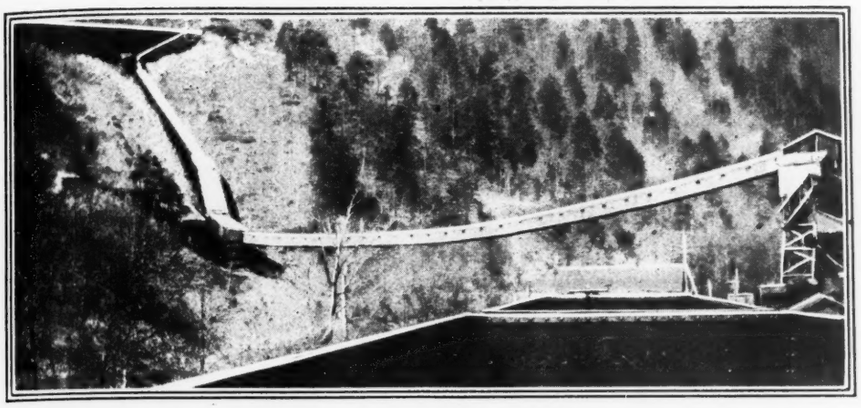
Each spiral tube has an upper and lower



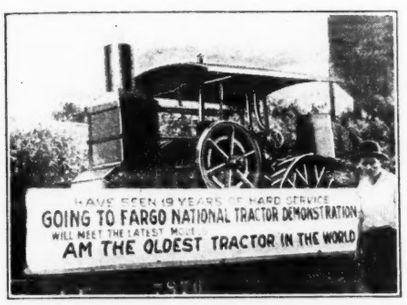
Spirals in a drum utilize the heat of the waste gases

outlet to the room air, the colder lower air entering at the bottom of the drum and escaping at the top after being heated in the tubes; thus a saving in fuel is effected. This constant passage of cool air is said to absorb nearly all the heat from the gases.

Midair Conveyor Hauls Coal across River



AT Wilbur, West Virginia, there is a coal-mine on one side of the Guyanette River and a railroad on the other. There isn't any bridge, and there isn't any ferry, so the coal is delivered from the mine to the cars over a belt-conveyor 504 feet long, suspended by steel cables a hundred feet above the water. The coal is brought down the mountainside and delivered to the conveyor at a point on the river bank directly opposite the bunkers where cars are loaded for shipment. The conveyor-belt is protected by a housing large enough for a man to pass through in order to inspect and care for the equipment.



Nineteen-Year-Old Tractor Still on the Job

NINETEEN years old and still on the job, this is undoubtedly the oldest operating tractor in the world. The photograph was taken during its first threshing season in northern Minnesota in the autumn of 1903. That same summer the queer round cooler was changed for one of the square type, but with that one change the same tractor was driving threshing machinery this fall. During the past eighteen years old Number Five has threshed close to a million bushels of grain and broken over five thousand acres of prairie, besides doing a large amount of miscellaneous road and hauling work. Its present owners, the Stromgren brothers of Kennedy, Minnesota, insist that the machine is good for many more years of hard work. Its record shows what service can be obtained from well-cared-for machinery.

PASSENGERS traveling from Paris to London over airplane lines are now able to reserve theater seats *via* wireless while in flight. The wireless equipment on the plane transmits the message to the landing-field, from where it is telephoned to the theater.

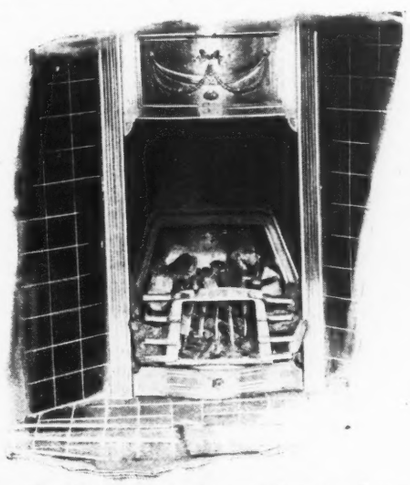
Not a Professor

THE name of J. Newton Kugelmass appeared in the October issue of POPULAR SCIENCE MONTHLY with the title, "Professor of Chemistry, Johns Hopkins." This title was used with Doctor Kugelmass' name through error, as his connection with Johns Hopkins University is that of a graduate student.

New Grate for Fireplace Keeps Coal Burning Steadily

WITH the average grate, we shiver at breakfast while the newly lighted fire smolders, and it is usually some time before it burns up sufficiently to warm the room appreciably. Every time fresh coal is shoveled on the fire it has a deadening effect. Few persons possess the art of burning small coal in an ordinary open grate with satisfactory results.

It is claimed the furnace grate illustrated will overcome these objections. As will be seen, it consists of a framework of metal bars that is placed in an ordinary fireplace after removing the front bars. Coal is piled on top of the frame and round the sides and back. Paper and sticks are placed in the hollow framework and lighted, and the coal, once ignited, slips through the bars by degrees into the hollow space. In a short time the whole of this space appears white hot and continues in this condition as long as there is coal above and around it. The addition of fresh coal has no deadening effect at all. Small coal can be burnt as well as larger and it is said that 50 per cent more heat is obtained from the same amount of fuel.



The frame work of metal bars in the fireplace keeps the fresh coals from smothering the fire

It's Easy to Strike Out in Indoor World's Series

REAL fielding and batting skill is required to play a new indoor baseball game. The ball is pitched by a spring gun, and must be actually struck by the batter. If the batter does not offer at the ball, the pitch counts as a strike if it lands in the net; but if it hits the backstop, it is a ball. When the ball is hit, the runners are advanced by turning the thumbscrew at third base, which moves forward all the men on bases, since they all are fastened to a movable belt running around the bases. It requires considerable skill to move the men rapidly, and it is by no means easy to pick up a batted ball on the end of the gun and touch the runners out.

Thus the game is by no means a cut-and-dried affair like the "baseball games"

It takes a keen eye to aim straight with a spring gun

that depend on the fall of dice. The ball is partially filled with shot, so that it is seldom batted off the board.

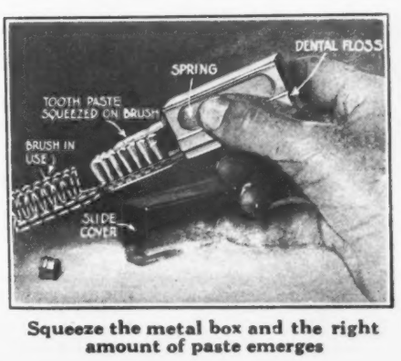
SUNFLOWERS have proved very successful as silage for cattle in localities so high above sea level that corn will not grow. Hundreds of acres in eastern Oregon have been seeded to sunflowers in the past year.

Vest-Pocket Toothbrush Box Supplies Paste, Too

EXTREME compactness has been secured in a vest-pocket toothbrush container and paste-holder, invented by Dr. R. H. Lieberthal, of Bridgeport, Connecticut. As packed, the brush is placed so that paste may be squeezed directly upon it by pressing a flexible spring insert in the metal box. The brush is then slipped out of its slot.

The upper part of the holder, containing the paste, is made so that any "sample size" tube may be used. On the end opposite the brush is a container for a supply of dental floss.

When closed for packing, the metal cover is slipped over the whole outfit.



Squeeze the metal box and the right amount of paste emerges

Reel Pulls Wire from Duct with Greater Safety

WHEN telephone linemen pull wire from underground ducts through the streets, many accidents result. The danger is now eliminated by the use of a pulling reel that has a mechanical advantage of six to one.

A certain wastage of wire in the old hand method is also eliminated. According to experts of the New York Telephone Company, this duct-wire pulling-reel was developed after careful consideration of a power-driven reel.

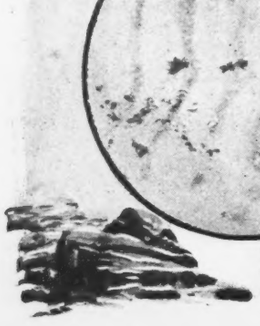
Sea-Gulls Find Way to Crack Sea Urchins' Shells

AS an illustration of how Nature furnishes even the birds with the food-getting instinct, consider the sea-gull and the sea urchin. Any one who has been near the ocean is well acquainted with the gull, but only those living along our Southern coasts know about the sea urchin.

The sea urchin is a species of shellfish with a shell that is covered by a forest of sharp pointed spines. These spines, of course, were given it as a protection against its natural enemies.

But the sea-gull in some way found out that the little shellfish with the sharp points was a tender morsel, once the shell could be penetrated. Unable to crack the shell with its bill, the bird has adopted a method that is as ingenious as it is effective.

It picks up the urchin by one of the spines and carries it to a height of fifty or more feet over a hard beach or ledge, then drops the burden. The fall usually smashes the shell of the urchin and then the gull's next meal is assured.



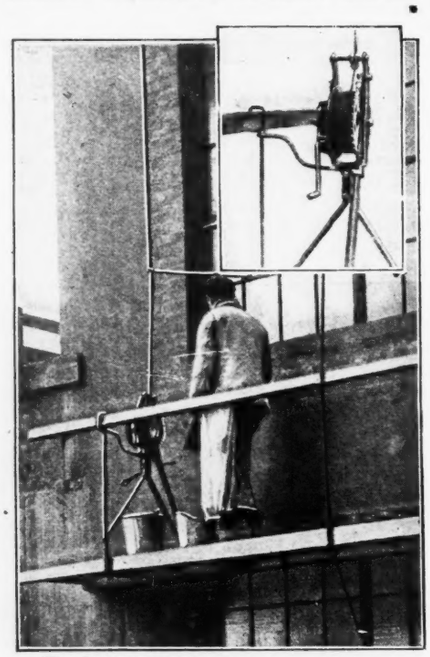
The gull carries the urchin high, then drops it to crack the shell

Hoisting Attachment Makes Scaffolds Safe for Workers

A SAFETY hoisting attachment designed especially for scaffolds of the swinging-ladder type, such as are used by painters, stone-setters, and stucco-workers, has been invented by Frank B. Johnston, of Rochelle Park, New Jersey.

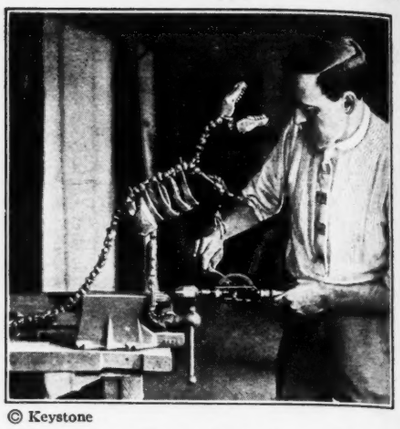
The new mechanism consists of a steel drum on which the hoisting cable is wound, attached to the conventional scaffold "irons." The drum has a ratchet wheel at one side, which is engaged by a pawl that prevents unwinding of the drum, save when the pawl is intentionally thrown out of connection. A hand lever connected with the drum permits of operating it by hand to wind up the cable and effect the hoisting of the scaffold. The drum is provided on its other side with a clutch, which can be thrown into engagement with a worm gear that meshes with a second worm carrying a crank, and by means of which the drum may be safely unwound to lower the scaffold.

The device takes up comparatively little space, as rope or cable not in use is wound up on the drum, where it is out of the way. The uncertainty and danger of the block and fall, and the necessity of untying and tying hitches in the rope whenever it is desired to raise or lower the scaffold, are entirely eliminated.



The hoisting cable is on a steel drum. A ratchet prevents unwinding

HARD-WOOD block pavement capped with half an inch of rubber was tested in the intersection of two of London's busiest thoroughfares. After eight years' service the pavement was taken up. It was found that most of the wear was on the under side of the rubber. The wear on the rubber surface was confined to scratches.



© Keystone

This Man Puts Life into Nuts, Bolts, and Springs

PROBABLY thousands have laughed at the antics of Major Herbert M. Dawley's prehistoric creatures in the moving-pictures. He has made the diplodoccus, the dinosaurus, the icthyosaurus, and their kind very real to audiences that never dreamed of meeting them in the movies.

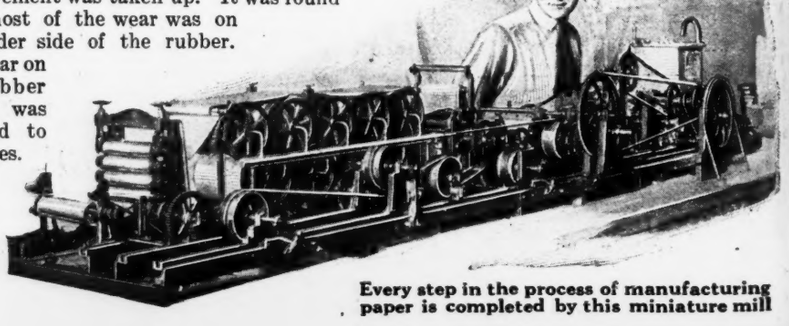
The skeletons are constructed with fair accuracy. Springs, bolts, and nuts are introduced so that the dummy animals appear lifelike in action on the comic strips. Major Dawley is forced to do most of the work himself, since scientific knowledge must be combined with ingenuity and skill with tools, in fashioning the models.

THROUGH sensitive electroscopic methods a patient scientist has measured the amount of radium in ordinary sea-water. The quantity was found to be .00000000-000386 per cent. Radium is found in nearly all substances, including the soil of the earth, but usually the percentage approaches that of radium in water.

Tiny Paper-Machine Makes Real Paper in Four-Inch Width

SOME of the bearings in the smallest paper-mill in the world are as finely adjusted as those of a watch. Its construction is a marvel of model-making skill, for the machine will actually manufacture paper from wood pulp in one unbroken operation, demonstrating every step in the process.

The model is about one twentieth the size of a paper-making machine, its length over all being nine feet, while the commercial machines weigh several thousand tons and are two hundred feet or more in length. The paper is produced in rolls only four inches in width, but in spite of the comparatively light weight of the rollers, the product is of standard quality.



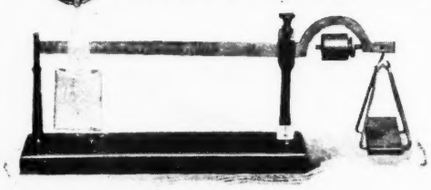
Every step in the process of manufacturing paper is completed by this miniature mill

Sensitive Scales Measure the Moisture of Green Wood

WHEN the moisture content of wood is to be determined with an apparatus recently invented, a green sample is placed in a pan on one side of the scale, and dust or sand is poured into an envelope hanging at the zero mark on the other side, until the two balance exactly.

The sample is then heated in a kiln until bone dry, and the envelope moved along the scale until the two balance again. The percentage of moisture is shown directly by the mark at which balance is maintained, since the scale is graduated in hundredths.

Cabinet- and furniture-makers must always know the moisture content of the wood they are making up, since it will always shrink or swell in proportion to the water it contains. In veneers, particularly, these lumps and hollows do not show until the furniture has been sold.



A sample of wood is balanced against an envelope of sand

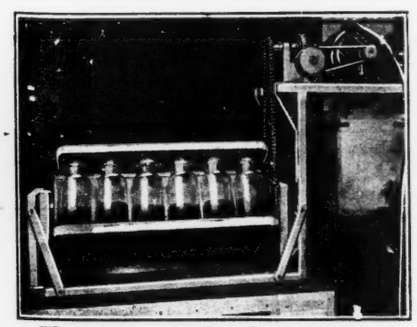
For furniture-making, stock should be dried to from 3 to 5 per cent of water, and of course the treatment of the wood in the kiln can be conducted more intelligently if accurate knowledge of the moisture in the green stock is available to the manufacturer.

WASTE rubber of all sorts can be re-used after it is passed through rolls which are cooled so that the kneading takes place below the fusion point of the sulphur.

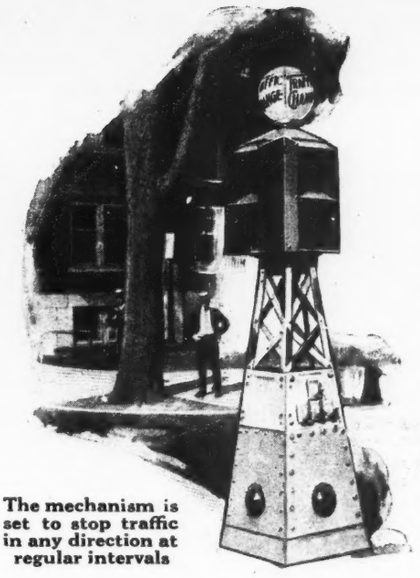
Miniature Tannery for Studying Chemistry of Leather

IN a miniature tannery, only two and a half feet long, Prof. A. W. Thomas, of Columbia University, is making a careful and scientific study of the chemical reactions involved in tanning.

Although men have known how to tan hides for thousands of years, chemists are still in the dark as to just what chemical action takes place in the tanning-vat, and why a solution of oak-bark should turn raw hide into flexible leather. With his little tannery turning out two-inch-square pieces of leather, Professor Thomas expects to do away with hit-or-miss tanning methods, and by scientific control to produce better leather and eliminate the waste of material that takes place at present.



The tannery, 2½ feet long, turns out pieces of leather 2 inches square



The mechanism is set to stop traffic in any direction at regular intervals

Automatic Lights Handle Traffic in Milwaukee

THIS automatic signalling-post has been placed on the busiest street corner in Milwaukee, and has proved that it can do the work of approximately three traffic policemen.

It is so arranged that the patrolman on duty can set the mechanism to stop the traffic in any direction for any given period, according to the time of day, or to meet unusual conditions. For instance, in the morning, about schooltime, it can be set to control the north- and south-bound traffic for a longer time than the east- and west-bound traffic, because, at that time the former is congested with school children. The regulating mechanism can be set to change the direction of traffic at any interval between twenty seconds and ten minutes.

Besides the lower warning lights, which show red at all times, there are three lights above. The top light is a big white bulb, reading "Traffic Change," which flashes when the signals are about to alter. "Stop" is shown in red letters, and "Go" in bright green.

A Blindfolded William Tell

If he hits the potato, he'll prove his skill as a swordsman

AN officer of the British army, Sergeant-Major Aggleton, is demonstrating his mastery of swordsmanship and the delicacy of his sense of touch by cutting a potato in half with a sharp sword-bayonet while it rests on the neck of a fair volunteer.

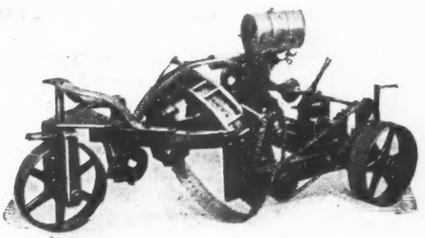
The marvel of the feat is the fact that the swordsman's eyes are blindfolded as he strikes the blow.

Circular Saw Cuts Stumps Ten Feet in Diameter

AN interesting new stump-cutting machine is so placed that when in use the stump rests inside the circular saw.

In operation, the circular bandsaw, which is run by means of chain and sprocket gears, revolves at a speed of twelve hundred revolutions a minute. The saw is "fed" down to the base of the stump by means of a lever and cuts through the stump under the ground at a depth of thirty inches. There is, therefore, no possibility when plowing of coming in contact with a hidden stump. The annular saw can be tilted to any angle desired, and as the machine is mounted on wheels it is easy to start the cut from any direction.

The cutter is made in two sizes—eight



The bandsaw revolves at a speed of 1200 revolutions a minute

and twelve feet, so that with the larger-size machine a stump approximately ten feet in diameter can be removed. A small six-horsepower gasoline engine supplies ample power to run the saw.

PNEUMATIC road-rammers, working at a pressure of about 75 pounds and giving more than 400 strokes a minute, are being used to consolidate concrete laid on the great highway between Marseilles and Nice, France. A new kind of concrete is being used. After this is hammered down into the subgrade, then smoothed by a steam-roller, it forms an unusually hard, smooth surface and is ready for traffic 48 hours after laying.

Adding-Machine Fits Any Typewriter

ANY typewriter becomes an adding-machine when equipped with an attachment that fits above the top row of keys and is operated by the regular numeral keys of the machine. It works independently of the typewriter mechanism and is screwed to the face of the machine with two clamp screws.

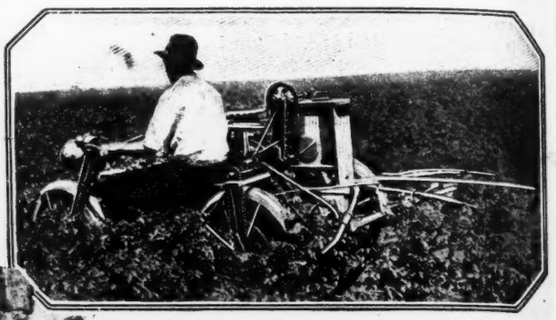
As the operator touches the numeral keys, the attachment automatically adds, and gives a continuously visible total. The attachment is cleared for any other column by touching a button. By turning another key, the device will subtract.

The attachment is operated by the numeral keys of the typewriter

The Up-to-Date Farmer Hitches His Wagon to a Motorcycle

Victor Anderson uses his motorcycle for light hauling. He just hitches his machine to a cart and turns on the gas

James Rollins rescued an auto from the junk-pile and turned it into a hay-wagon. His second-hand cycle pulled the whole outfit



J. Schroeder attached a sprayer to the side-car of his motorcycle and drove the bugs out of his Minnesota potato patch

"HITCH your wagon to a motorcycle," is the proverb on many a farm these days as the old mare walks out of the shafts and the long-established one-horse rig goes to join the barnyard relics.

More than one farmer is beginning to use the motorcycle as a light tractor to haul the load of hay, to pull the milk-cart and to spray the potato patch—in fact, to perform any one of a dozen odd jobs for which the horse is too slow and the automobile or tractor too unwieldy.

Out in Minnesota, for instance, J. Schroeder had a 310-acre potato patch that was overrun with bugs. It looked like a total loss until he hit upon the idea of attaching a dust-spraying machine to the side-car of his motorcycle and driving the combination between the rows.

He attached an extra gear chain to a sprocket on the rear wheel, and the engine supplied power for the duster. With this outfit Schroeder was able to dust 190 acres a day with Paris green, whereas a horse-drawn duster could not have covered much over 35 acres. His crop was saved, for in the hot, dry weather prevailing at that time, a day's delay might have resulted in total loss.

Similarly, Victor Anderson of Warroad, Minnesota, uses his motorcycle constantly for light hauling, and declares it works perfectly. But James Rollins of New York goes him one better. Rollins is running a farm without a horse. He owns a second-hand motorcycle, and for a farm wagon he uses an old auto that he picked up for a song when it was on its way to the junk-pile. The motorcycle has not the slightest difficulty pulling the easy-running wagon.

Portable Vacuum Tube Outfit Makes Deaf Hear

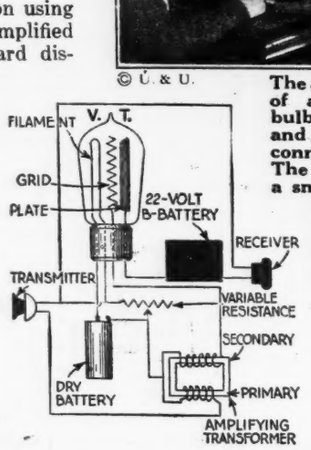
VACUUM tubes that can augment the sounds of the human voice from sixty to a million times are now restoring hearing to the deaf.

The audion set that amplifies the faint signals received by wireless until they can be heard throughout a large auditorium, has been reduced in size and weight until the perfected apparatus is compact enough for a person to carry with him. With the device, sounds that would be inaudible to a partially deaf person using an older type of apparatus, are amplified to a point where they can be heard distinctly. A person of normal hearing using an audion set would be deafened temporarily by the noise.

By placing an amplifier in a phone line, the sounds are increased to such an extent that a person can hear by the vibrations transmitted to the auditory nerve through the bones of the head. Heretofore the relief that the telephone has given to deaf people has been restricted because of the inefficiency of the carbon-grain transmitter.

© U. & U.

The amplifier consists of a single audion bulb, with dry cells and 22-volt battery, connected as in radio. The set, contained in a small case, is connected into the telephone circuit and amplifies the human voice about fifty times

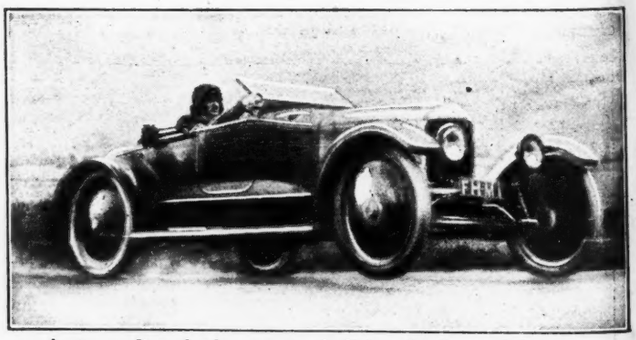


The ordinary ear phone is used in the amplifier, but a small audion bulb set is connected with the apparatus. This set is contained in a case about nine inches square by three inches deep, and consists of a single audion bulb with standard dry cells and 22-volt B battery, connected in the same manner as in a radio set.

The audion tube comprises three elements—the filament, the grid, and the plate. Current ordinarily passes from the filament to the plate, or from negative to positive. However, the amount of energy transmitted is controlled by the charge on the grid. A negative charge here, for example, will oppose the negative charge from the filament. As soon as the sign of the grid changes to positive, it will aid the plate to draw current from the battery through the filament's ionic discharge. A cycle of this nature continues as long as the transmitter is spoken into, and the original impulses are constantly being amplified in volume. The ordinary instrument amplifies the speaking voice about fifty times.

Camouflage Converts Ford into a Sport Model

IN the hands of an English automobile company, the lowly American Ford has become a distinctive sport-car model. On the basis of the standard chassis some startling bodies have been constructed. Changes include lengthening the frame and setting it closer to the ground; fitting a gasoline tank, supplied with a vacuum system, at the rear, and the addition of disk wheels. An electric lighting and starting system, a small collapsible top copied from those usually seen on the most expensive machines, and a sport windshield make the transformation complete.



A streamline body, a set of disk wheels, and larger frame are part of the equipment that turns the Ford into a sport model

Instrument Responsive to Heat of Fifty-Mile Distant Candle Measures Energy of Invisible Stars

Power from the Milky Way Runs Tiny "Motor" on Earth, Disclosing Strange Secrets of the Heavens

By Henry D. Hubbard
United States Bureau of Standards

THIS is the story of how a government scientist has been running a "motor" by star power from the Milky Way! Stated thus, the marvelous accomplishment of Dr. W. W. Coblentz, of the United States Bureau of Standards, in measuring the heat energy of invisible stars, may seem to be part of a fairy story, yet the phrase quite fairly represents Dr. Coblentz's achievement.

How delicate must be the apparatu with which these star measurements were taken can be realized from such facts as the following:

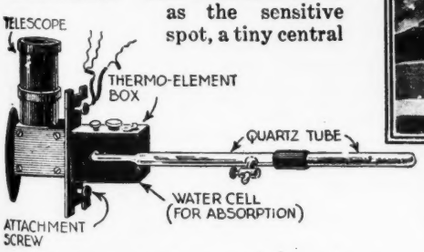
The great red star known as Betelgeuse is 27,000,000 times bigger than our sun, and yet one second of sunlight, as it reaches the earth, is more powerful than 60,000 years of the starlight that reaches the earth from Betelgeuse. Nevertheless, the heat from this star could be easily measured by the Coblentz apparatus, which, in terms more familiar to us who aren't astronomers, is sensitive enough to respond measurably to the heat of a candle fifty-five miles away.

Electric Current from Starlight

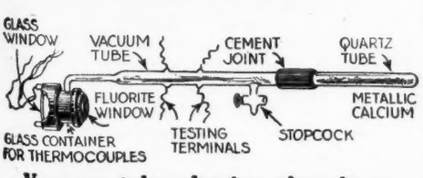
In his experiments, Dr. Coblentz made use of the power of a welded joint of two different metals to transmute heat into electric current. The procedure is simple. A bimetallic joint—say of platinum and bismuth—placed in the end of a telescope, receives the starlight and transforms it into electric current that can be measured—measured not in amperes, however, but in ten billionths of an ampere!

You can easily picture this apparatus to yourself. Imagine a hair-thin platinum wire with a flat end, on which a dot of thin bismuth has been pressed by a hot needle, forming a weld as small as the period which ends this sentence. This weld is to serve as the sensitive spot, a tiny central electric power plant run by the star power it is to measure. The welded joint—called a "thermocouple"—with its almost invisible connecting wires, is placed in a vacuum tube fitted with a fluorite window. Fluorite is used because it is transparent to all the star rays, visible and invisible, while glass is as opaque as iron to certain rays.

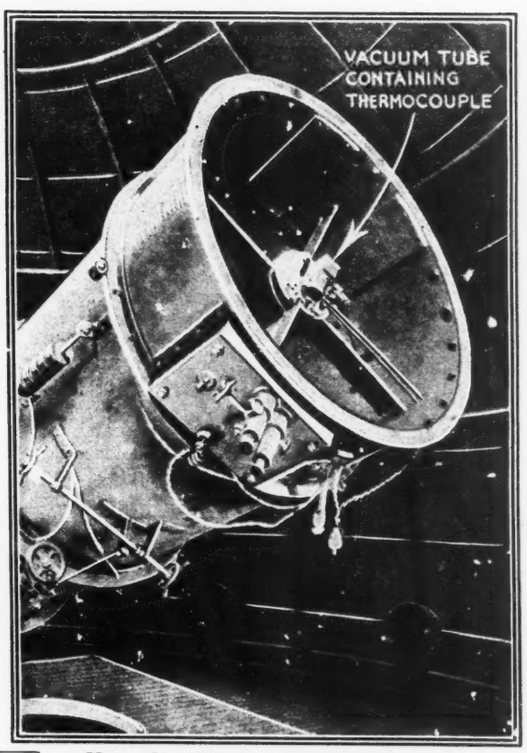
To maintain the vacuum in his first tube, Dr. Coblentz attaches to the latter a quartz tube containing calcium. Now, when this calcium is heated, it absorbs the residual air and other gases, thus keeping the vacuum tube air-free without an air pump.



The assembled apparatus ready to insert in the end of the telescope to receive the starlight



Vacuum tube, showing the glass housing for the tiny sensitive weld



How the delicate thermocouple is placed in the telescope

Connected with the thermocouple by almost invisible wires, there is a galvanometer consisting of a fine wire coil and tiny swinging mirror. The whole marvelous instrument, you see, is beautifully simple in principle. When it is properly placed, the star's heat falls through the fluorite window on to the welded joint in the vacuum tube, and a current of electricity is promptly generated. This current flows through the fine connecting wires into the coil, and thus turns very slightly the little mirror. The rest is easy. The angle of turn is determined by observing a scale reflected by the mirror, and so measurements of the current and of the star's heat are obtained at the same time, for both are just in proportion to the turn of the mirror.

Dr. W. W. Coblentz of the United States Bureau of Standards, wizard of star-heat measurement

From the patient research that Dr. Coblentz has conducted with this apparatus, a harvest of discovery has resulted. He has measured the heat or radiant energy from one nebula, from 105 stars, from Venus, Mars, and Jupiter, from our moon, and two moons of Jupiter, and from the rings of Saturn. His results show that the total light from all visible stars steadily shining on a thimble of water for a century would not heat it one degree—and yet he has actually measured the heat from a single star.

As to the actual heat of stars, Dr. Coblentz found none as hot as 10,000 degrees and some as low as 3000 degrees. He found, too, that a star's heat is not to be judged by its brightness, for a red star emits three times and a yellow star twice the heat that an equally bright blue star radiates.

The Mystery Is Cleared

An interesting discovery concludes this glimpse into the magic world of delicate measurement. In the winter constellation of Orion, there is a bright blue star, "Rigel" (technically "*beta Orionis*"). Dr. Coblentz measured its total radiation, visible and invisible. Then he used a layer of water to observe the invisible "infra-red" rays which carry most of a star's radiant energy. Contrary to the rule for blue stars, Rigel showed an excessive amount of infra-red—a startling result that could not then be explained.

The mystery was recently cleared in a most interesting manner, when Director Plaskett, of the Dominion Observatory of Victoria, British Columbia, discovered that Rigel is moving rhythmically toward and from the earth in a local orbit that only a companion star could produce. The excess infra-red from Rigel, detected by Dr. Coblentz, clearly belonged to the dark companion star, thus leaving Rigel the normal proportion of red to blue. The companion star was not perceived because infra-red rays affect neither the eye nor the camera.

Dr. Coblentz is planning new conquests, with equipment so sensitive that with a seven-foot reflector it will respond to the head of a candle 500 milles away!

Cyclist Tries Jumbo Tires to Break the Shocks

BICYCLISTS who feel the need of shock-absorbers might do well to follow the idea of the rider who rolled clumsily through the streets of London not long ago on tires large enough for a truck.

They weren't really truck tires, but were special thin-walled bicycle tires made to order. For general use, they might make rough ways smoother, but the price would be hard on the pocketbook.

The front and rear forks were extended to hold the tires. Special wheels and rims also were required to accommodate the huge tires.

MOST scientists have been of the opinion that the flying fish merely makes a long leap above the water when it "flies," using its long, winglike fins to support itself as it volplanes from one wave to the next.

H. H. Clayton, eminent meteorologist, declares the flying fish uses its tail and fins as if swimming while it is in the air, so that actually it both jumps and flies in its long leaps.

National Capital Snapped from Three-Mile Height

A BIRD'S-EYE view of Washington, D. C., snapped from a height of three miles above the city, holds the record for clarity in high-altitude aerial photography. Special films, prepared by the United States Army Air Service at Bolling Field, made possible photography from this great height.

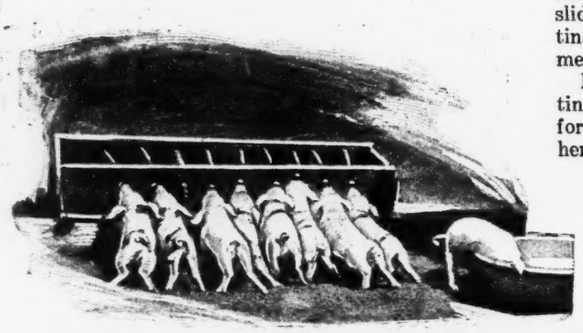
The usual film could not be used because it is orthochromatic—that is, sensitive to only a few colors. The special panchromatic film—sensitive to all colors, and the sort employed during the war to locate camouflaged guns—was used. This film deteriorates so rapidly that it must be treated before each flight to restore the original sensitiveness.

The photographer was equipped with a standard aerial camera with a 12-inch lens and made an exposure of 1-200 second at stop F 4.5.

Special color-filters were used to penetrate the ground haze that ordinarily would prohibit photography from such a height.

Bottle-Rack Mothers Nine Pigs

AN old chicken-trough became foster-mother to nine pigs when their mother died. Their owner cut slots in one side of the trough and fastened nine milk-bottles in a row. Each bottle was fitted with a rubber nipple, and the rack was tilted to insure a steady flow of nourishment.



Woman To Be Uncle Sam's First "Rangerette"

THE job of watching for "smokes" as fire lookout in the Devil's Head station in the Pike national forest, Colorado, became too tame for Miss Helen Dowe, so this year she tried her hand as "chainman" on a government surveying party that ran a transit line across one of the roughest parts of the San Juan Mountains in southern California. Accompanied by a chaperon, she became a member of a regular surveying crew.

Working at the head or rear end of a 330-feet steel chain and tramping through forests, across streams, and over rock-slides, she stuck to her job with a pertinacity and courage that amazed the men of the crew.

Miss Dowe may soon have the distinction of becoming Uncle Sam's first forest "rangerette," for in addition to her work with the surveying party she established a record for efficiency in fire detection unsurpassed by any man who ever held the job. Government Civil Service examinations for positions as rangers in the national forests were recently opened to women physically qualified for the work.

Mackerel Tails for Hat Trimmings

AT last—a use for fish tails! With a little drying and dyeing they can be converted into trimmings for women's hats.

Lester Pringle, director of the preservation laboratories of the United States Bureau of Fisheries at San Pedro, California, has perfected a process for turning out tails that look like lacquered wings. The tails of mackerel weighing two pounds are ideal for the purpose, he says. He exposes them to the sun, then dyes them to match the shade of the hat.

The proteid in the tails prevents the dyes from running or fading.

Miss Mary McConnell, of San Pedro, was the first woman to trim her hat with mackerel tails that look like lacquered wings

Skyscraper Bungalow Is All the Style

BUILDING bungalows on the roofs of New York skyscrapers is becoming an accepted commercial enterprise to add to the income from the buildings. The cost of erecting this cozy dwelling atop the Textile Building was about $10,000, and the owners expect it will rent for about $4000 a year.

The bungalow overlooks the Metropolitan and Madison Square Garden towers. On the northwest and the west, it is shielded by other buildings. Thus it is protected from wintry winds.

Potted shrubs and vines will make the roof a garden spot.

Rubber Beauty Mask Irons Out Wrinkles

FOR faces that are wrinkled with worry or the flight of time comes a rubber beauty mask direct from the laboratories of the British Institute of Science to remove blemishes and restore fair skins.

The mask was produced after much experimenting with habitual frowners. It is made of medicated rubber and may be worn either during sleep or during work. Experts advise, however, that the best time to slip it on is when nobody is looking, as its beauty is of the kind that frightens the neighbor's children. It can be adjusted to the face with very little difficulty.

Here is a beauty—not just now, perhaps; but wait until the medicated rubber mask is removed!

Holstein-Friesian Cows Are Hostesses at Lunch

EIGHTY-SIX Rotarians and seventy thoroughbred Holstein-Friesian cows attended lunch together recently in dairy barns at Battle Creek, Michigan. While the banquet was ostensibly given by W. W. Wentworth, a member of the association, the real hostesses were the Holsteins; for the lunch was held in their home and a quart bottle of milk was placed before the plate of each guest.

The remainder of the luncheon was prepared in the kitchens of near-by hotels. The banquet was a demonstration of the progress made toward absolute cleanliness in dairies.

Who enjoyed the banquet more—the Holstein-Friesian cows or the Rotarians who were their guests?

New Clover Saves a Year in Crop Rotation

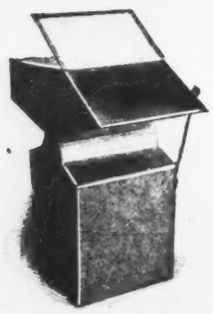
ONE year is saved in crop rotation by a new variety of white clover that reaches its full growth in one season, supplying the soil with as much nitrogen in that time as the usual biennial white or yellow sweet clover produces in two years' growth.

As the usual period of crop rotation for corn land is five years, of which two are assigned to clover, this newly exploited plant may increase the productivity of some farms by 20 per cent.

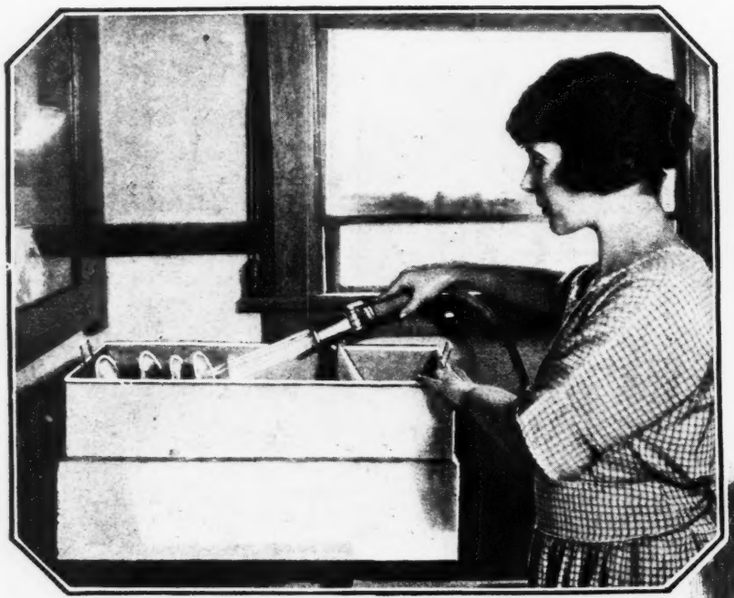
The clover has always been native to some parts of Alabama.

Annual white clover will grow seven feet high in five months. It is excellent for hay and for bee food

Here Are a Dozen New Ideas to Lighten Housework



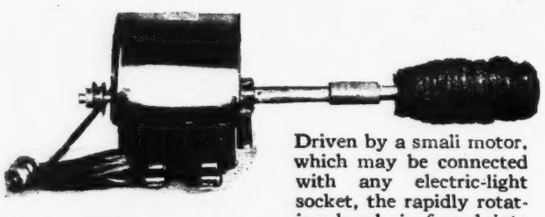
Put the contents of the furnace ashbox in the upper compartment of this device, close the cover, and rock the box. The ashes will drop into the ashcan below, leaving the cinders



Dish-washing becomes less irksome when it is done by a powerful stream of hot soapy water from the nozzle, which is connected with the service faucet and operated by hand

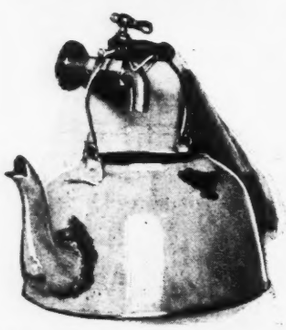
Excessive moisture may be removed from the air in any room by using the above device. It is a container of perforated aluminum filled with a chemical substance that absorbs moisture

One of these folding service-trays is very useful in the small apartment. Dishes may be placed on the tray in the kitchen and wheeled to the dining-room. After dinner, the used dishes may be loaded on the tray and taken back to the kitchen

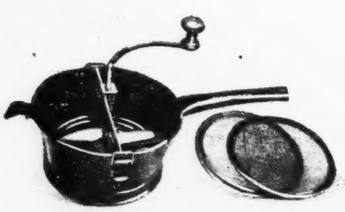


Driven by a small motor, which may be connected with any electric-light socket, the rapidly rotating brush is forced into the bottle half filled with warm water and quickly removes all dirt adhering to the inside

Cooked fruits and vegetables may be preserved for an indefinite time by the method illustrated. The food to be preserved is placed in a jar with a rubber-packed cover. The jar is placed in the container and the air is then pumped out

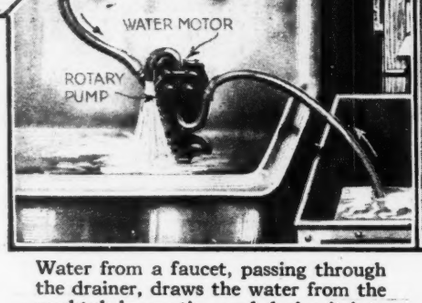


The wire device shown here is clamped around the faucet and holds the teakettle while it is being filled with water. It will hold buckets as well and will protect the sink enamel



This cutter and masher has rotary knives and rollers so arranged that the fruits and vegetables cut by the knives are pressed through the sieve by the rollers

With this soap-shaver, soap may be quickly cut into thin slices. Each time the knife cuts, the feeder-bar changes its position to the correct distance for the next cut of the shaver

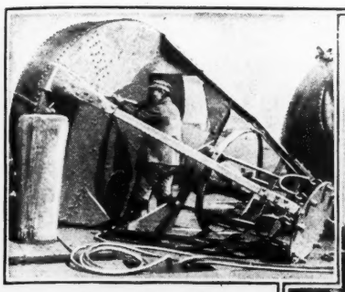


Water from a faucet, passing through the drainer, draws the water from the washtub by suction and drains it into the sink

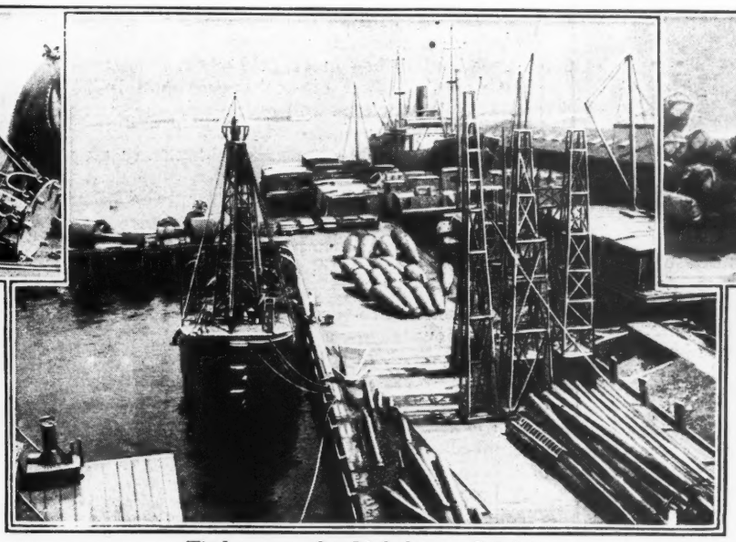
Three resistance units supply the heat in these electrified logs that can be placed on the andirons of the ordinary open fireplace

Screw-caps can be easily removed or tightened by this adjustable clamp, which will fit any size of fruit-jar cap. The wire of the wrench is placed in the top groove of the cover

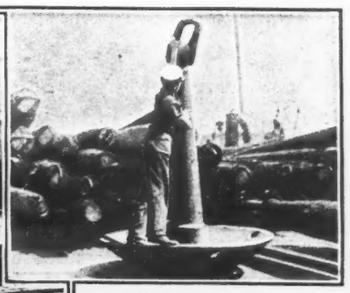
Look Behind the Scenes with the Lighthouse Service



Annually each bell-buoy is hauled in from its station for repairs. Barnacles and rust are scraped off and the buoy is repainted



Tied up at the Lighthouse Service dock, a lightship is being painted and repaired. On the wharf are a number of whistling buoys



The mushroom anchor that must hold a heavy, seagoing buoy at its station, is carefully tested to see that it is in condition for service

MECHANICS employed at the dockyards of the United States Lighthouse Service on Staten Island, do their work with the knowledge that safety of ships at sea depends upon the reliability of the lights and buoys. They know that any defects in chains or anchors, or any incomplete repairs, may result in disaster at sea and loss of life. Lights must be kept burning, and markers must hold fast to their anchors.

Into this "service station," lightships and buoys are hauled for repairs and repainting, better to withstand wintry gales and heavy seas. In many cases, opportunity for repair comes only once a year. The self-lighting or flashing buoys, which are perhaps the most important beacons along America's coasts, will burn every night for from six to twelve months with one filling of carbide, and when they are finally brought in for repairs they are covered with weeds and encrusted with barnacles.

The size of this equipment is always a surprise to landsmen. Giant mushroom anchors must be used to hold the buoys on their station, for a fair-sized buoy is from eight to ten feet across, stands twelve feet above the water, and weighs many tons.

A relief lightship and spare buoys, spars, and lights are kept at the dock, ready to be rushed to sea in case of emergency. Lightships and buoys are anchored with the heaviest chains possible, but occasionally a chain will break after being rammed by a steamer in a fog or caught in an ice-pack, and a new light must be put in place.

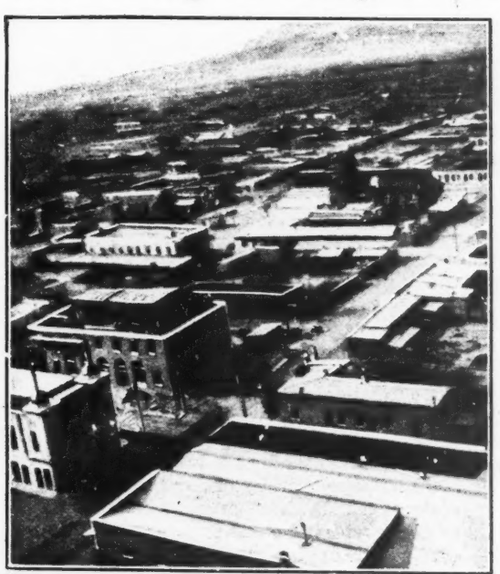
Camera Climbs Kite-String to Snap Pictures from the Air

BIRD'S-EYE views similar to those photographed by aerial observers during wartime can be taken by any amateur with an apparatus consisting of an ordinary kite, a camera, and a special carrier that sends the camera up the kite-string to the desired height, snaps the picture, and brings the camera down again for reloading.

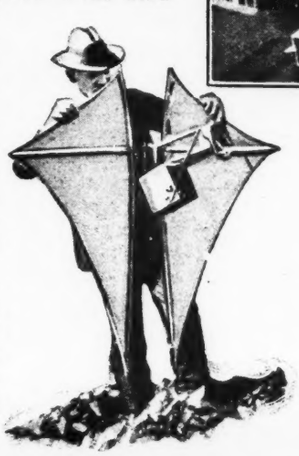
The secret of taking a picture such as is reproduced in the accompanying illustration lies in the carrier, which is equipped with wings. When the kite is sent up, an obstruction about the size of a lead-pencil is attached to the cord at the point from which the picture is desired. After this obstruction has reached the required elevation, the carrier, with camera attached, is placed on the kite-string with wings extended, and the force of the wind carries it up the string. When a lever in front of the carrier strikes the obstruction, the camera shutter is tripped. Immediately afterward the wings are released and the carrier slides down the kite-string.

There is no danger of breaking the camera if a stout kite-string is used, for the string, particularly with the weight of the camera upon it, takes the form of a catenary curve, and the part of the string near the ground is nearly horizontal. Accordingly, as the camera nears the ground, its speed of descent is reduced until it glides easily into the photographer's hands.

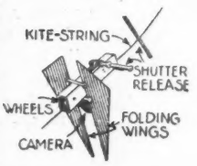
If the wind is not in the direction of the view to be photographed, the camera can be reversed. The speed with which pictures may be taken depends upon the weight of the camera and the strength of the wind. Actual tests have shown that a breeze of from six to eight miles an hour is strong enough to lift the camera. With average velocities of from 18 to 20 miles an hour, an ascent has been made in eight seconds. Box cameras of fixed focus have given the best results.



The kite-camera acted as its own photographer when the bird's-eye view, reproduced above, was taken



At the left is the carrier, with wings extended and the camera attached. The manner in which the carrier climbs the kite-string until an obstruction trips the camera shutter is shown at the right

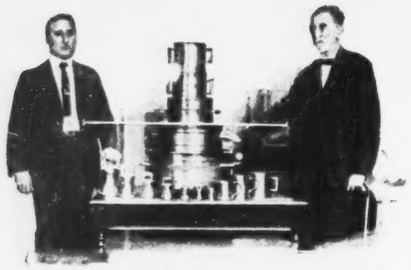


Can Bees See Colors?

THREE eminent American scientists are starting experiments to determine whether bees and other insects are color blind.

Theologians generally maintain that the colors of flowers are for man's delight, while biologists believe the colors are there to attract insects that carry the pollen from blossom to blossom.

At present, some scientists believe that bees can see blue, but not red; and that they may react to ultra-violet rays which do not affect human eyes. Doctors F. E. Lutz, J. Arthur Harris, and F. K. Richtmyer, of the National Research Council, are attempting to settle this dispute.



Find Original American Set of Weights and Measures

THE original American set of standard weights and measures, presented to the colonies by King George the Second, has recently been discovered in Alexandria, Virginia. The set consists of a yardstick, weights from one to a hundred pounds, and all measures of capacity both dry and wet. They are cast from solid brass, and marked Fairfax County, 1744.

Experts from the Department of Agriculture declare this is the only complete set of the standards used in colonial times in the United States, and that it is a priceless historical relic. They are owned by T. Ballanger, city market-master of Alexandria, who stands at the right of the set.

THAT half the gasoline pumps in the state of New York give the consumer short measure is the estimate of the New York state director of weights and measures.

It is said that while no type of gasoline pump is absolutely infallible, most will give correct measure if properly operated. The shortages reported varied from a half pint to a gallon on a three-gallon purchase.

Small Birds Form Great Colony of Nests

EXTRAORDINARY methods are adopted by the little society birds of South Africa in building their nests. The photograph shows a mass of nests the size of which may be measured by comparison with the horses on the ground below.

The birds are no bigger than a canary, and each pair builds a mud nest of diminutive size. But thousands of them nest in the same tree, and each year a new nest is built, until the branches are covered. Eventually the weight of the nest becomes too great for the tree, and the colony falls; or all available space is occupied and a new colony is started on a tree that is situated near by.

Thousands of birds nest in one tree, forming a colony of mud homes

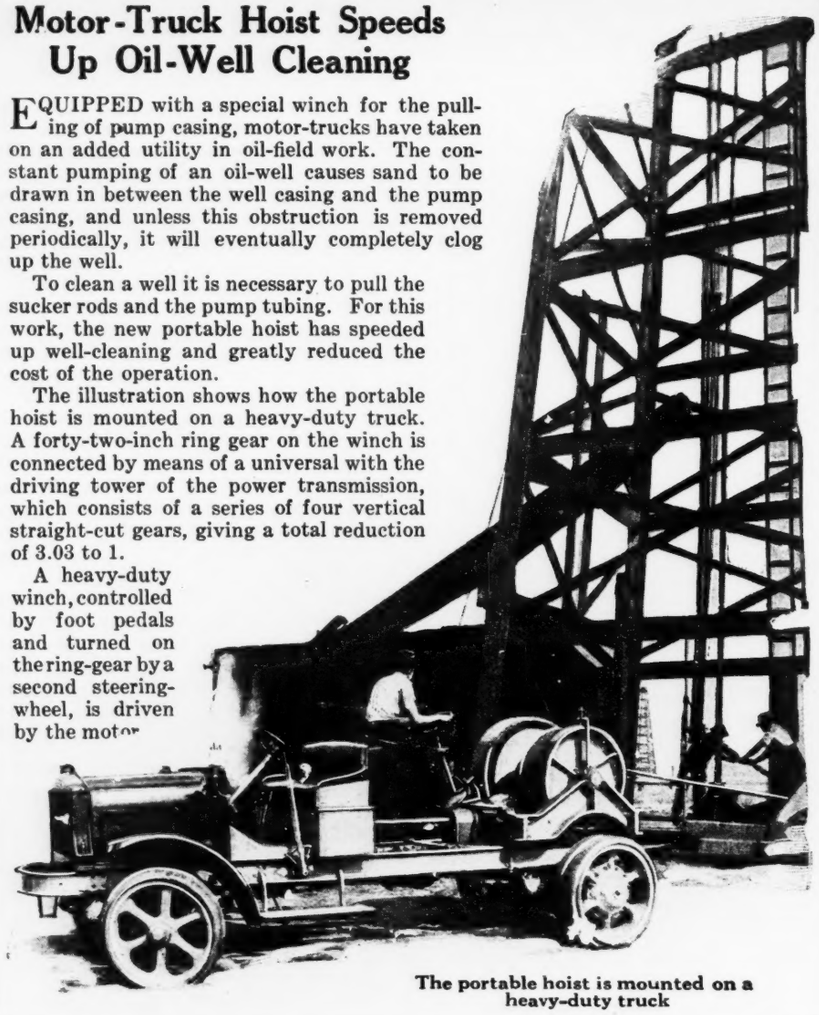
Motor-Truck Hoist Speeds Up Oil-Well Cleaning

EQUIPPED with a special winch for the pulling of pump casing, motor-trucks have taken on an added utility in oil-field work. The constant pumping of an oil-well causes sand to be drawn in between the well casing and the pump casing, and unless this obstruction is removed periodically, it will eventually completely clog up the well.

To clean a well it is necessary to pull the sucker rods and the pump tubing. For this work, the new portable hoist has speeded up well-cleaning and greatly reduced the cost of the operation.

The illustration shows how the portable hoist is mounted on a heavy-duty truck. A forty-two-inch ring gear on the winch is connected by means of a universal with the driving tower of the power transmission, which consists of a series of four vertical straight-cut gears, giving a total reduction of 3.03 to 1.

A heavy-duty winch, controlled by foot pedals and turned on the ring-gear by a second steering-wheel, is driven by the motor



The portable hoist is mounted on a heavy-duty truck

Lighted Match Starts Fifty-Horsepower Pump

IF a lighted match is held close to the fusible plug on the latest improved automatic sprinkler, the system springs into action instantly, with a deluge of water backed by the pressure of a fifty-horsepower pump.

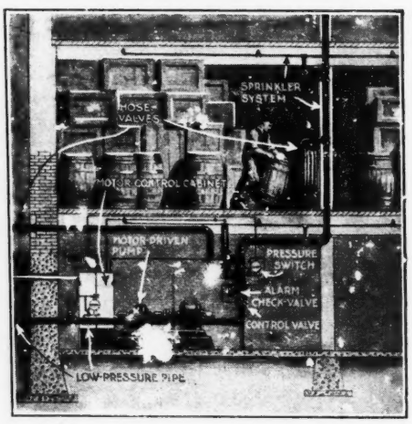
One of the drawbacks to the universal use of the automatic sprinkler for fire protection has been the fact that the city water pressure in some of America's largest towns has been inadequate for sprinkler systems in moderately high buildings.

By putting an electric booster pump between the city connection and the sprinkler riser pipe, one company has made its system independent of low pressure.

The pump operates whenever an open sprinkler head reduces pressure in the lines, or whenever water starts to flow at any pressure. This dual automatic feature makes the pump more than ordinarily reliable.

The pressure-boosting equipment consists of a centrifugal pump direct-connected with an electric motor automatically controlled by a standard starter panel. To insure that the motor shall always be in running order, a special test valve discharging water into a sewer has been installed. This valve is opened and shut electrically from a central station five miles or more from the building in which it is installed, and permits the apparatus to be tested periodically.

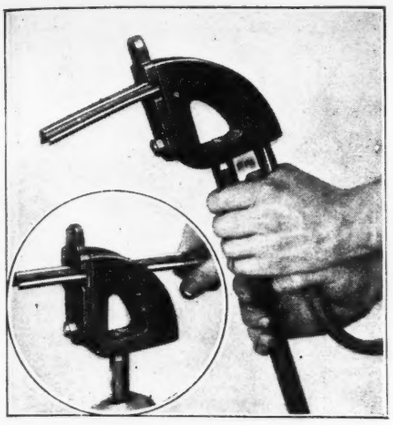
When this system is installed, no structural changes to the building are necessary, and the pump and controlling panels occupy only a small space in one corner of the basement.



This cutaway view shows how an automatic sprinkler system operates

---

REPORTS that a new "missing link" in the history of the evolution of man has been discovered in a fossil skull dug up near London are exciting scientists throughout the world. The skull represents a primitive type previously unknown. It is believed to antedate even the Neanderthal skull, which itself is so early that many scientists believe it to belong to a race somewhat similar to, but not identical with, mankind, which man (*Homo sapiens*) fought, destroyed, and replaced.



Conduit-Bending Tool for Surface Wiring

ELECTRICIANS will appreciate the simplicity of a useful tool for bending wire conduit. It is so designed that with a little skill, any kind of bend or offset may be formed over the quadrant. The long handle makes it as easy to shape the conduit close to the ends as in the middle.

The conduit is held in place by the swinging lock, and is bent by applying pressure with the hands close to the tool. In this way the mold for the wires is bent on close, easily fished radii, so that the wires can be pushed through the pipe without jamming. The handle is not furnished with the tool, which is intended for use with a patented conduit. About two feet of half-inch pipe should be used.

Foot-Power Plow Turns Up Eight-Inch Furrow

This plow replaces the spade in the garden

THE suburbanite will find spading up the back garden an easy job if he equips himself with the foot-operated plow recently perfected by a European inventor.

The plowshare digs a furrow but eight inches deep, as the invention is intended for use only in small gardens where the soil is soft, and not for use by the farmer.

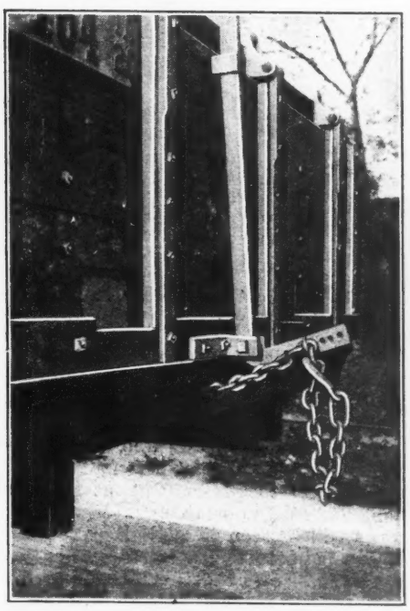
The plow is pulled forward by pushing one pedal down with the foot, and at the same time pushing the handle-bars forward with the arms. The power developed reaches the plow through a series of levers that multiply the muscular effort many times, and the inventor claims that the work is not exhausting—and indeed is far less severe than using a spade.

THE Kaieteur Falls in British Guiana, are formed by the Potaro River, a tributary of the Essequibo. The river, at a width of 350 feet, falls over a barrier of rocks from a height of 750 feet. The Kaieteur Falls are five times the height of Niagara Falls. They represent a potential energy estimated at 2,350,000 horsepower, while that of Niagara is estimated at only 1,250,000 horsepower at present.

Hinged Truck-Door Spreads Gravel Evenly

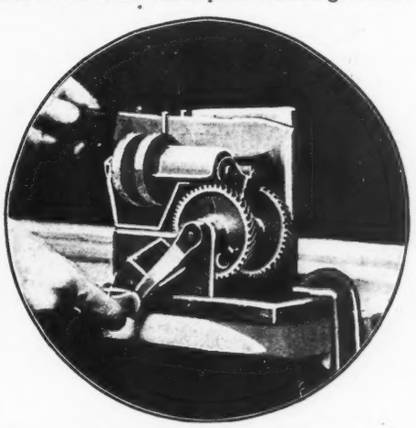
GRAVEL is spread evenly over Iowa roads by a hinged door invented for use on dump-body trucks by engineers of the Highway Commission. An L-shaped lever is attached with its fulcrum point near the bottom edge of the door on the center line. A chain attached to the floor-sill of the body bottom is carried out and fastened in one of the holes bored in the right-angled portion of the lever below the fulcrum point.

When the lever is hooked at the top, the door is held tightly closed. As the lever is lowered, the door opens, and the opening can be maintained at any desired width. Dry gravel sifts through as evenly and smoothly as desired. Wet gravel requires jiggling of the lever and a larger opening to get the material through. Although the device costs little to install, it is necessary to have a man for operating it.



Rotary Knife-Sharpener

A SIMPLE rotary sharpener, the action of which is automatic and demands no skill from the operator, has been designed for the housewife whose kitchen knives are dull. It puts the same edge on the knife as the manufacturer puts on in the first place. The knife is placed between the two rollers on the top of the instrument, and while the grinding wheels are turned the knife is sharpened by being drawn back and forth past the two grinders.



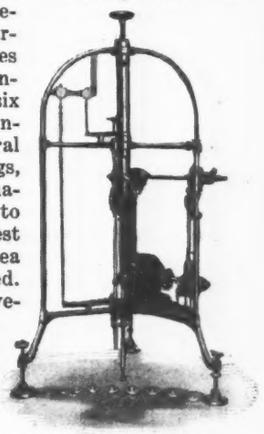
Two revolving grinders put a keen edge on the dull kitchen knife

Crushing Dried Shrimps for a Chinese Delicacy

ORIENTAL fishermen traditionally use corrugated wooden rollers to prepare shrimp flour, a Chinese delicacy. For the Chinese restaurants in the United States, the shrimps are sold boiled in salt water. Only American restaurants will buy them fresh from the sea.

Subgrade Tester Imitates Traffic Loads

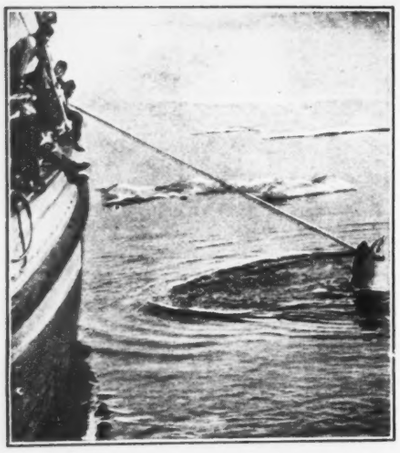
VARIABLE loads, similar to those borne by a subgrade when a vehicle passes over the surface of the road, are applied to the roadbed by a new subgrade tester perfected by the Illinois Highway Testing Laboratory. The instrument consists of a spring to produce the pressure, a cam by which the force is varied, and a plunger to transmit it to the soil being tested. A one sixth horsepower direct-current motor drives the cam at a constant speed of six revolutions a minute, and several different footings, seen below the machine, are used to distribute the test load over the area of subgrade desired. The vertical movement of the subgrade under pressure is read on the dial at the left.



A spring produces the pressure for testing the soil

In making the test the machine is levelled by the set screws on its legs until the face of the plunger is parallel to the surface of the soil. As the motor revolves the cam, the pressure on the road varies from zero to a maximum of fifty pounds a square inch six times a minute, which is an approximate imitation of stresses produced by the wheels of an average-sized motor-truck.

CHINESE housewives who do not live in or near one of the trading centers, do not use soap of animal origin, as do their sisters in the West; they use a native substitute made from the beanpods of two trees, botanically known as *Gymnocladus Chinensis* and *Sapindus Hukorossi*. The soap from the *Sapindus* pods is whiter than that from the pods of the other tree and is used, as a rule, for cleansing the more delicate white clothes.



Fighting Polar Bears Harpooned from Canoes

FOR real excitement few forms of hunting can equal the capture of a polar bear with a harpoon, which is a popular sport among the Eskimos of northern Alaska. The bear is a fierce fighter when aroused, and the hunting usually takes place from a skin kayak easier to capsize than a canoe, instead of a comparatively large ship, as in the illustration. The polar bear can swim almost as well as a seal, and his great strength often makes the struggle last for at least an hour before he is exhausted.

The bears are harpooned in the summer, when the ice breaks up into cakes and the bears are forced to swim from place to place. A harpoon is used instead of a rifle to prevent the animal from sinking beneath the surface, as it would do if shot.

Telephone Receiver, Invented for Army, Hangs on Ear

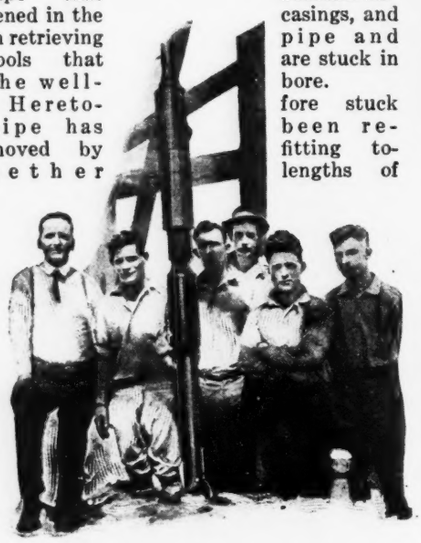
A TELEPHONE receiver light enough to hang from the ear, so that one may answer a call with both hands free, invented for military use, is now available for commercial purposes. The lobe of the ear slips into a hollow in the rim of the receiver.

The device was invented during the war, and used with great success by the German army. Only recently the government permitted the inventor to publish photographs of it.

IN England, chalk, blended with a rich carbonaceous material, the basis of which is coal-tar, and molded into briquettes the size of a lump of coal, is being used as a fuel substitute. It is said that the fuel gives out greater heat than coal, burns more evenly and for a longer time, and produces a minimum of ash. The chalk is employed to conserve the heat and make the fuel more lasting. No observable smoke is given off during the combustion of this synthetic fuel.

Reversing Tool Goes "Fishing" in Oil-Well

OIL-WELL drillers can save from two thousand to five thousand dollars on every fishing job—of which there are usually many in the course of drilling an oil-well to any considerable depth—by using a new reversing tool instead of a string of left-hand pipe, according to C. R. Edwards, of Houston, Texas, inventor of the machine. The tool is used in withdrawing pipe that becomes fastened in the casings, and in retrieving pipe and tools that are stuck in the well-bore. Heretofore stuck pipe has been removed by getting together lengths of



The reversing tool can recover pipe or tools stuck in the well-bore

pipe with a left-hand thread and lowering them into the bore until the stuck pipe is reached. Then they are given a turn to the left. This method calls for the use of hundreds of feet of left-hand pipe, which is never on hand, but has to be procured specially.

The new tool is only about three feet long and easily portable.

As will be seen from the illustration, it is divided into two parts. Interior gears are so connected that when the upper part of the tool is turned to the right, the lower half turns to the left, thus giving the stuck pipe the left-hand turn necessary to release it. The gears also give power, so that in case a pipe cannot be unscrewed, the machine is strong enough to twist it in half.

The tool can be used in open-hole wells as well as in casings. Its practicality has been demonstrated in the Blue Ridge oil-fields, where 1900 feet of pipe was removed from a well 3400 feet deep.

Dilutometer Tests Quality of Crankcase Oil

IT is called a dilutometer, because it wouldn't be right to name a thing used to test oil a hydrometer, but it shows the exact conditions of oil in the engine crankcase just as the hydrometer shows when the storage batteries need attention.

The greater the dilution of the oil, the further this instrument will sink into it. Graduations along the stem show when the oil is good, fair, poor, and dangerous through loss of its lubricating powers. In this way the car-owner can get the utmost mileage out of his oil.

SOME dealers have increased the sale of Satsuma oranges, which ripen while their skins are still green, by exposing them to the fumes of a gas-engine. This treatment turns the skins to the golden color demanded by the public.

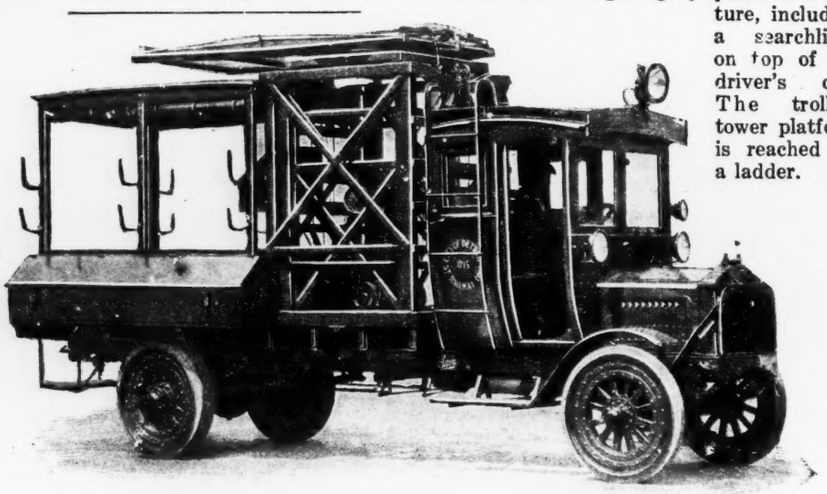
Motor-Truck Speeds Up Trolley-Repair Service

HIGH-SPEED trolley repair service is facilitated by a motor-truck with a trolley tower that can be raised hydraulically by a hoist operated from the engine.

The hoist, which can raise or lower the platform in less than one minute, is similar in design to the hydraulic hoist in common use on dump-trucks.

To the rear of the tower is a covered motor-truck body that has large tool-boxes on the sides having hinged covers placed at an angle so that the interior of the boxes may be readily accessible.

Full electric-lighting equipment is a feature, including a searchlight on top of the driver's cab. The trolley-tower platform is reached by a ladder.



A hoist, operated by power from the truck engine, raises or lowers the repair platform in less than a minute

Fountain-Type Wash-Basin more than Ornamental

SAVING in floor space and a great advance in sanitation are effected by the "wash fountain," designed for public lavatories and factory washrooms. Every user is insured a plentiful supply of absolutely clean water, and since every one washes under a flowing jet, there is no opportunity for germs to collect.

As compared with old-fashioned wash-bowls, the saving in floor space is considerable. Bowls for twenty-four people require a minimum of ninety-one square

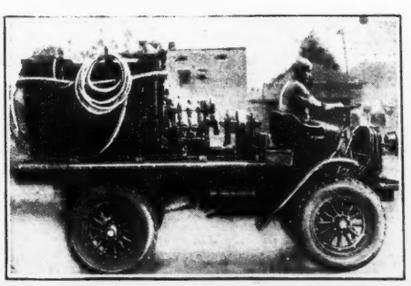
The flow of water is converted into a fine spray for the "wash fountain"

fountains occupying sixty-four square feet.

Although the contrary would seem to be the case, economy is also secured in the use of water. The fountain illustrated, for example, can be used by six persons at once, and yet it consumes no more water than the amount piped for one washbowl. This is accomplished by converting the flow into a fine spray. The fountain is built of a combination of marble chips and concrete, ground and polished.

What One Inch of Rain Means

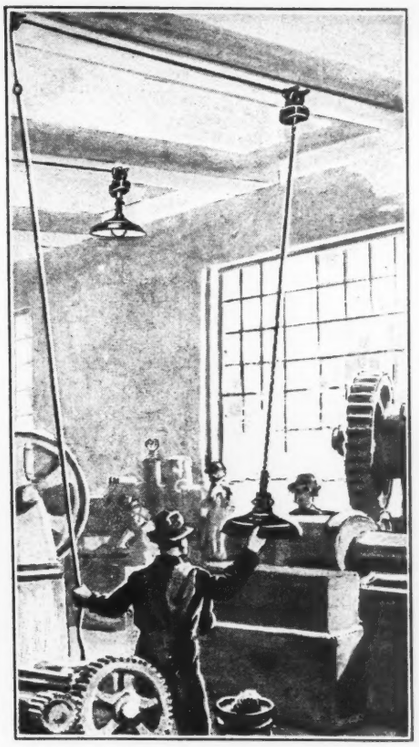
WHAT does it mean when the Weather Bureau reports that one inch of rain fell in a certain locality in 24 hours? It means that enough rain fell to cover the ground with one inch of water. A sheet of water one inch thick and covering one acre would contain 6,272,640 cubic inches of water. This would be the equivalent of 27,143 gallons of water, representing a total weight of 226,512 pounds. It would fill a tank 20 feet square and 9 feet deep.



Gives Eighteen Mules a Vacation

ONE of the largest fruit concerns of the San Joaquin Valley recently discovered that a spraying attachment mounted on a motor-truck and operated by the truck's engine did the work of their entire spraying outfit of eighteen men, eighteen mules, and nine spraying machines.

The spraying-pump is connected with the engine by means of a chain to the transmission.



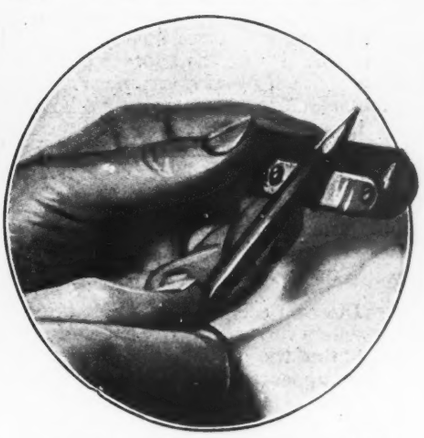
Cleansing Is Safer when Lamps Are Lowered

PLACING factory lights on cords so that they may be lowered to the floor when it is necessary to clean them has already saved the lives of many washers, and enabled a larger number of lights to be cleaned in a day.

The old practice was for the worker to climb on a ladder and balance precariously over moving machinery, continually running the risk of serious accidents. It frequently happened that the product being manufactured was damaged when falling glass from a broken shade or globe dropped into the machinery. Twenty feet of cord arranged as in the illustration has done away with these perils.

Pencil-Sharpener Catches Chips

SUCH a pencil-sharpener as this that keeps the chips from falling on the floor will please the housewife. In this one, a steel blade is mounted over a slot in a hollow handle, so that all the shavings fall out of sight as fast as they are cut from the pencil. When the tool is full, the lower section opens like a jack-knife, and all the chips can be placed in the waste-basket.



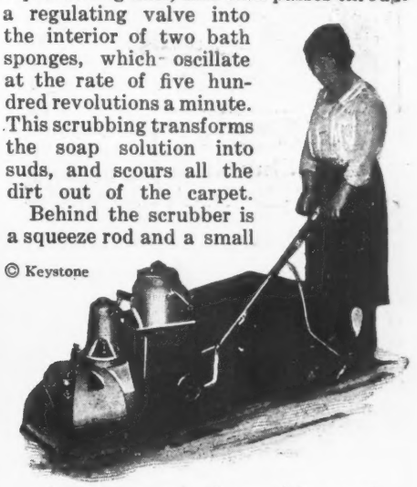
All the shavings fall into a slot rather than on the floor

Electric Cleaner Scrubs Carpets with Soap and Water

NOTHING but the purest soap and water is used in a novel household carpet-cleaner, which washes the rugs while they are in place on the floor. A solution of soap in hot water is placed in the can at the rear. The liquid runs through an electric superheating unit, and then passes through a regulating valve into the interior of two bath sponges, which oscillate at the rate of five hundred revolutions a minute. This scrubbing transforms the soap solution into suds, and scours all the dirt out of the carpet.

Behind the scrubber is a squeeze rod and a small

© Keystone



bath sponges in the machine scrub the carpet with soap and water

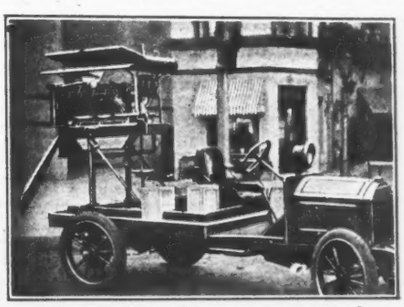
vacuum cleaner. These press all the water out of the nap of the rug, at the same time sucking up all the moisture and dirt into a lower container at the back of the machine.

The rug is left almost dry after the machine has passed over it, and it is said that the mechanical cleaning will not injure the fabric or coloring of any rug.

Wind Machine Makes Gale Come from Any Direction

IN one of the Western movie studios a machine made up of a small airplane engine and propeller furnishes the wind for the blizzards through which the movie hero staggers with the heroine in his arms, while five strong villains crouch in the shelter of a boulder and are overwhelmed by the drifts.

The interesting feature of this wind-producer is the pivoting of the platform. It may be tilted forward or backward by turning a hand-wheel in the rear. This improvement is introduced in order that the angle at which the wind strikes the



The wind producer, on a pivoted platform, can be tilted by turning a hand wheel

actors can be adjusted to suit the nature of the ground on which the scene takes place.

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY.

Baker Builds a Sugar Church

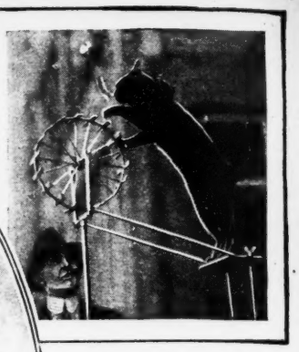
SUGAR—just plain sugar, tinted and flavored—was the material used by C. Mendel, a baker-architect of New York City, to build a complete model church. The bricks in the walls are of pink strawberry; the roof is chocolate-tinted, and the window-panes are clear rock sugar.

Mendel erected the church during his spare time, working with a confectioner's decorating tool such as is used to adorn cakes with fancy frostings. It was a slow, painstaking task, for the slightest jar would have destroyed the building.

Wave-Washed *Memphis* Proves Strength of War-Ships

EVER since the United States cruiser *Memphis* went ashore on the coral reefs off Santo Domingo in March, 1915, it has stood like a fort against the battering waves of the Caribbean Sea. The vessel lies in an exposed position, and for almost seven years the heavy seas have washed her decks.

In spite of this terrific assault, which frequently sends the spray over the tall funnels, the *Memphis* remains intact, as shown by the photograph reproduced above, which was taken only a short time ago. Thus the old *Memphis* stands as a monument to the skill of American naval shipbuilders. Few merchant vessels could have withstood such a pounding for more than a month.



Found: A Cat with Brains

CAN a common house cat be taught tricks? A. Techow, of New York City, has proved that it is possible, in spite of the tradition that the cat, while accepting man's protection, persistently refuses to obey him.

Mr. Techow's method is to take advantage of the cat's fondness for play, never to force a trick to the point of weariness, to make the performance enjoyable, and to give rewards for good performances. Amateurs who say that a cat can't be trained should look at the foregoing illustration.

THE condition in ice-cream known as "sandiness," caused by the formation of crystals of lactose or milk sugar, can be prevented by pasteurizing. Rapid freezing increases these crystals, which are one tenth as soluble as sugar.

Is This World's Biggest Drum? Four Men Carry It

A BASS-DRUM four feet wide and four feet in diameter has recently been made by Odell Chapman, of Willimantic, Connecticut. It is said to be the largest drum ever built. When the drummer hits it with his drumstick, people near by think that a thunderstorm is approaching.

When the drum goes on parade, four men are needed to hold it, while the drummer walks by its side and gives it an occasional thump, which is all that is needed.

Every time he beats the drum, the townspeople think it's a thunderstorm

German City Has Smallest Paper Money in the World

ZEULENRODA, a city in Thuringia, Germany, issues the smallest paper money in the world. The note illustrated is for one pfennig, and is only two and a half by one and three quarters inches in size. It is worth approximately one thousandth of a cent in American money at present quotations of the mark, but even so, it is probably not the least valuable money in the world. That distinction is held by the paper of lower denominations issued by the Russian Soviets.

Was Your Solution Right?

Did you solve Sam Loyd's brain-twisters correctly? On page 75 you will find the answers to the puzzles that appeared in the October issue. Names of prize-winners appear on page 74, with a brand new set of puzzles to juggle with.

UNLIMITED amounts of electrical energy may be obtained from the atmosphere, according to Hermann Plauson, of Hamburg. A captive balloon having a metal cover provided with a large number of pointed projections is used to collect positive electricity, which is transmitted from the balloon to the ground by a wire rope fitted with a spark gap.

Sightseeing by Electric Chair Is New Fad in Zoo

A NUMBER of small electric vehicles have been put into operation at the New York Zoological Park, to carry visitors along the miles of paths that wind between cages and animal houses. The innovation has been hailed as a blessing by mothers who formerly dreaded a trip with the youngsters to the zoo. Attendants operate the chair for one dollar an hour.

The elephant doesn't worry about the new fad as long as there are "eats"

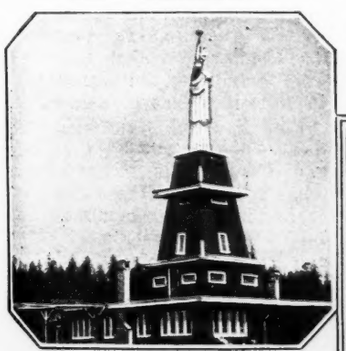
© K. & H.

England Has Traveling Hospitals for Cattle

CARAVAN dispensaries for the treatment of diseases in cattle travel through the country districts of England and are proving a boon to the stock-raiser. An expert veterinary surgeon accompanies each wagon, and sick animals are brought for treatment from miles around to each stopping-point.

Quarters for the doctors are not provided in the wagons, which are devoted wholly to medicines and equipment for the stock. An inspection service is rendered by the members of the party. Contagious diseases in outlying districts are promptly reported and isolated before the epidemic has an opportunity to spread among the herds.

THERE is no better medicine for complaining motor-car brakes than one part of castor oil to six parts of gasoline or denatured alcohol. Apply the mixture with an oilcan. The gasoline carries the oil to all parts of the brakes, and applied in this dilute form, there is little danger of their slipping.



Statue of Liberty Tops Forest Tavern

NO hidden significance is connected with the Statue of Liberty built above a forest inn near Seattle, Washington.

The proprietor, a patriotic man, built the figure during the war. Once up, it proved an unusual advertising sign. A light in the torch makes the location of the tavern conspicuous at night for miles around.

BARON EDMOND DE ROTHSCHILD is reported to have given a French scientific institute an endowment of 10,000,000 francs. The funds are to be administered by a council of distinguished men, largely to finance independent investigators in physics and chemistry. Colleges and universities will not have a share in the endowment.

Electric Keys Control Dictating Machine

ELECTRIC touch control for both the dictating and transcribing machine, is the latest invention of interest to the office manager. The business man in dictating his letter, now need only touch a flat switch under the mouthpiece of the speaking-tube to start or stop the rotation of the wax cylinder recording his speech; while with equal ease, the transcriber, typing a letter, simply taps either one of two electric keys, attached on each side of the typewriter frame, to start or repeat the dictator's voice.

Formerly, mechanical control for the transcriber meant foot pressure to start the machine, as well as much twisting and turning of the cylinders to repeat connecting phrases in the dictation. With electric control, stopping and repeating are accomplished by magnets under the carriage of the machine, with current supplied from any lamp-socket. Manipulating the control keys becomes part of the typing operation, as natural to the typist as using the space-bar.

To start or repeat the dictator's voice, the typist merely taps electric keys attached to each side of the typewriter

"Firemen's Football" Is Wet Sport

PUSHBALL, with a fireman's hose as the pusher, is no dry game as it is played in England. Even the spectators are liable to go home drenched. Each side has four men and a hose and the object of the game is to push the ball over the line by the force of the stream of water. Touching the ball with the hands, or even with the nozzle of the hose, is a foul.

The game calls for clever manipulation of the nozzle to keep the ball from sliding off to the side. When this happens—as it does every few seconds—the hose carriers have to show speed to get their line behind the ball before the other side has scored a point. All the players wear rubber boots and waterproof clothing, yet they are usually drenched before the game is ended.

CORN thousands of years old was found in a prehistoric grave in Tennessee. Experts identified the grain as Many Rowed Tropical Flint, a variety about halfway between true Flint and popcorn.

Searchlight Sleuth Spots Burglars

IN one of the exclusive residential districts of Los Angeles the private police, deciding that patrolling the streets was not sufficiently distinctive, have worked out a de luxe and highly effective system of catching thieves and protecting homes.

In the center of the little community, a high tower with a searchlight has been erected. At night an operator is stationed on top of the platform.

When a call for the police comes in, the home which sent the alarm is at once flooded with light from the powerful searchlight, which also follows the burglar if possible when he attempts to make a getaway. Meanwhile an officer goes out in an automobile after the thief, whose chances of escaping with his loot are slim.

Can You Explain These Every-Day Wonders?

Common Questions That Unlock the Secrets of Science

1. What useful articles are made from coal?
2. Why does milk sour?
3. Where does dust come from?
4. How does soap help to remove dirt from the skin and clothing?
5. How is artificial ice made?
6. Why is "water-gas" more dangerous to the user than "coal-gas"?
7. Why should gas be turned down low after water is boiling?
8. Why do radiators knock and rumble when steam is first turned on?
9. Why do thick glasses break more easily than thin ones when filled with hot water?
10. Why is toast prescribed for invalids and athletes?

These questions sound simple and easy to answer. But are they? Find out whether you really know the scientific principles back of the wonders of your daily life

Read the answers below

Take Five Minutes a Day to Master These A-B-C's of Science

Articles Made from Coal

1. If coal is heated in an enclosed vessel where the oxygen of the air cannot reach it, it will break down into many different products. First a gas is set free, that when washed by a spray of water, is used for illumination. After purification, the water is sold as ammonia water.

The most important product of the distillation is a dark brownish heavy liquid that when refined gives us tar, pitch, and the basic ingredients for dyes, explosives, and perfumes.

Why Milk Sours

2. Innumerable bacteria of many different kinds are always floating about in the air, and milk offers an excellent medium for their growth.

Among these bacteria are certain to be a few lactic-acid bacteria. These multiply very rapidly in milk, and as they live and grow they change the milk sugar into lactic acid. This acid gives milk the "sour" taste.

Where Dust Comes From

3. Dust is made up of particles of unburned carbon from smoke; fragments of wool, cotton, and hair; living organisms, and finely divided mineral matter. All are constantly being cast up into the air, and they slip through the cracks of houses and settle. After billions of billions of particles have fallen, we say the floor is dusty.

To the presence of dust particles in the air we owe the existence of fog and haze. Without dust to reflect the sun's rays, daytime would be dark.

After the eruption of Mount Krakatoa, dust thrown up by the explosion was carried completely around the world.

How Soap Removes Dirt

4. Soap has the power to dissolve the grease in which dirt is held to the skin or to clothing, and the loosened dirt particles are washed off with water. In this process the grease breaks up into tiny globules that are carried away by the soap solution.

In addition to this mechanical action, there is sometimes a chemical action. When dissolved in water, soap sets free some of its alkali, which again forms soap with the grease in the object being cleaned.

Artificial Ice

5. Gas grows warmer when compressed, and when it is allowed to expand, it absorbs heat from anything that may surround it. In making artificial ice, ammonia is compressed by powerful pumps and cooled by water. It is then allowed to escape through a small orifice surrounded by a jacket through which a solution of salt brine is circulating. As the ammonia gas expands, it must take up a large amount of heat, and this can be obtained only from the brine. The brine becomes very cold—several degrees below the freezing-point of water. The brine is then pumped around tanks filled with clear fresh water, which in forty-eight hours slowly freezes into cakes of artificial ice.

"Water-Gas" and "Coal-Gas"

6. Leaking water-gas is more dangerous than leaking coal-gas, since the former contains a much greater proportion of carbon monoxide, which is a dangerously poisonous gas with no odor to warn of its presence. Coal-gas is made by heating soft coal in an enclosed vessel. Water-gas is made by passing steam through a bed of red-hot coals.

Turning Down the Gas

7. Chiefly as a measure of economy, gas should be turned low after water is boiling. Water boils at 212°, and once that temperature is reached, any additional heat drives the molecules apart and produces steam. No matter how hot the flame, the water will stay at this temperature until it is entirely evaporated.

It is wise to use just enough gas to keep the water boiling. The food will cook just as rapidly.

Why Radiators Knock

8. There are two causes of radiator knocks. First, if the valve is only partly turned on, there is not enough room for the condensed water to drain back into the pipe and the steam to enter. The churning of the water inside the radiator produces the rumbling sound. As the air has already been pushed out by the steam, this water is moving back and forth in an almost perfect vacuum. It therefore moves in a solid mass, and when it strikes the sides of the radiator, the sound, and the blow itself is like that of a hammer stroke.

A second cause of knocking is the sudden condensing of steam. The steam enters water that has collected at the bottom of the radiator, and instantly becomes a drop of water 1-1700 of its former size. The rest of the space is a vacuum, which the water rushes to fill, and the "knock" is the sound of the impact as the sides of the water come together.

Why Thick Glasses Break

9. All solids expand when heated, and the hot water expands the glass of the tumbler. But glass is a very poor conductor of heat, so that in a thick tumbler the inside will expand before the outside is affected by the heat. This produces an unequal strain, which is relieved by a crack in the glass. In thin tumblers, the inner and outer surfaces are heated together and expand almost simultaneously.

Toast Easier to Digest

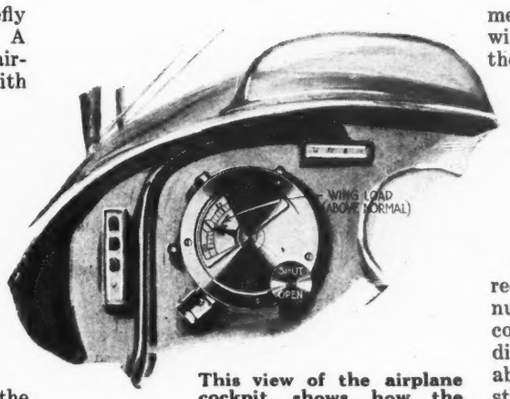
10. A perfect food is one that is readily absorbed without straining the digestive system and that contains the proper amount of nourishment in the correct proportions. Toast fulfils these conditions. Bread, when dried, is more readily acted upon by the ptyalin of the saliva, which is the principal agent in digesting carbohydrates such as bread. As toast is dry, it cannot be swallowed before it is properly chewed. This makes toast easier to digest than bread.

Wing-Load Indicator Safeguards Stunt Aviator

AIRPLANE stunts are limited chiefly by the strength of the plane. A skilful pilot can perform the most hair-raising zooms, side-slips, and spins with perfect safety so long as the machine will stand the strain. But with nothing save instinct to guide him, the pilot will sometimes strain the wings too far, and the result is a collapse in midair and a fatal fall.

To eliminate this hazard, a gage about the size of a watch has been invented to tell the pilot exactly the load that the wings are carrying. It is a German invention called a wing-load indicator. Besides its value in stunt flying, it is supplying aeronautical engineers with data on the maneuvers that place the greatest strains on the airplane fabric.

This indicator is installed on the instrument-board or on the fuselage, behind the wind-shield. It indicates how many times the wing load has risen or fallen above or below the normal flight load. If the needle in the indicator points to "2," for example, it shows that the wings are carrying, on the average, twice the load of normal flight. If the indicator points to 5, the pilot may expect the collapse of the lift surfaces.



This view of the airplane cockpit shows how the wing-load indicator is attached to the instrument-board, where the pilot may watch it constantly

The scale of the instrument is colored red from the numeral 2 onward. From the numeral 3 onward the entire sector is colored red. This indicates the immediate approach of danger. It is advisable in general not to force the airplane stresses beyond 2. Only part of the scale is visible at a time. The red of the quadrant is generally concealed so as to cause the pilot no undue anxiety.

Eighty-Foot Sea Wall May Save Filling Manhattan Extension

STREETS in four levels, and the reduction of earth fill to the minimum are now announced as the most interesting engineering features of the project to extend New York City six miles down the bay. At present there is a large shoal, beginning near the Narrows and running back to Governors Island, which consists of about 30 feet of silt and 11 feet of water resting on bedrock. Around this shoal the engineers propose to build a sea wall 80 feet deep and 12 miles long to rest on rock, and to rise 10 or 15 feet above high-water mark. It would be made impervious to water—virtually a great dam, more than 12 miles long.

When the dam is finished, it is proposed, not to pump sand and water into the enclosure, but to pump it out! "For why," it is asked, "should contractors go to great expense to fill the enclosure with earth, when the first thing builders will do in constructing foundations for skyscrapers is to dig up this fill and carry it away, while the city will be compelled to dig up the streets to build subways?"

Sand Will Be Pumped Out

In consequence, if the project is carried out, the sand already in this extension will be pumped out and on to barges, and will be towed across New York Bay to fill in the New Jersey meadows. In the great hollow thus prepared, protected from water by its 80-foot walls, strengthened by thick earth embankments, will rise a modern city built from bedrock without necessity for excavation.

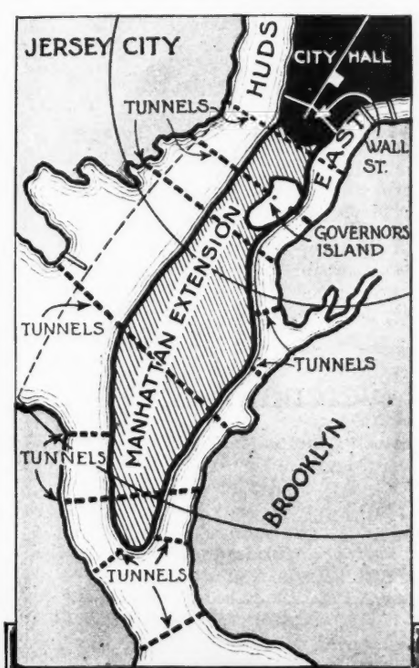
The streets of the Manhattan extension are planned to have four traffic tiers or decks. At the bottom next the rock will be the sewers, water-supply pipes, and electric and telephone wires.

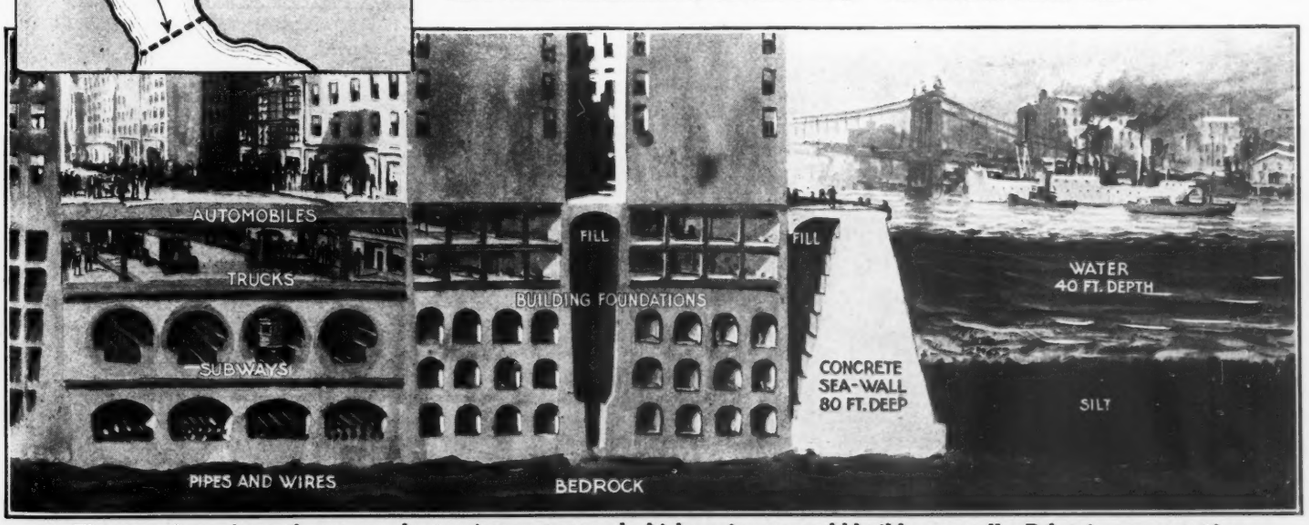
Staten Island Made Accessible

The deck above that for pipes and wires, will be for subways. These will run northward to Manhattan Island, eastward to Brooklyn and southward to Staten Island. Making Staten Island accessible to New York will almost double the conveniently situated living accommodations.

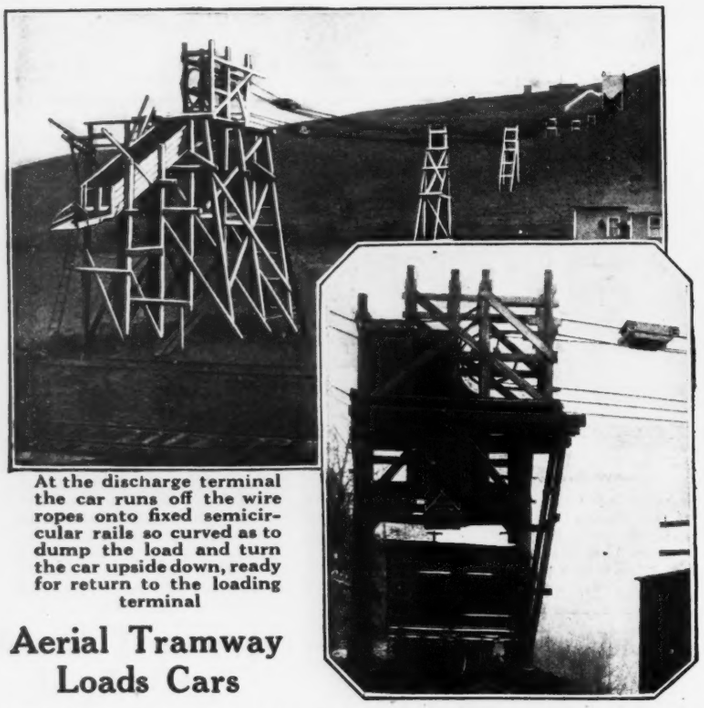
The third level will be a covered tunnel, ventilated by gratings set in the gutters of the street above, and given over solely to auto-trucks and business vehicles. If necessary, further ventilation will be provided by blowers. Buildings will be constructed with their shipping platforms on the first subgrade level, and the obvious consequence of the plan will be far greater speed in moving metropolitan freight.

The fourth level will be the open-air street, for passenger autos and pedestrians only. Congestion will be avoided, since the majority of the vehicles will travel on the covered street below.





The map above shows the proposed extension area around which engineers would build a sea wall. Below is a cross section of the contemplated street and skyscraper construction, with four traffic tiers and foundations resting on bedrock



At the discharge terminal the car runs off the wire ropes onto fixed semicircular rails so curved as to dump the load and turn the car upside down, ready for return to the loading terminal

Aerial Tramway Loads Cars

COAL from the pit-head travels automatically to the coal-cars down an aerial tramway in a mine at Peck's Run, West Virginia. The coal drops through a chute at the mine into trams, each equipped with four double-flanged wheels running on two parallel wire ropes. The cars are hauled by an endless rope, and are loaded and unloaded automatically while in motion.

The track ropes are divided into short sections by towers. Power is supplied either by gravity—in which case the loaded cars pull the empty ones up the hill—or by a gasoline motor at the loading tower.

The automatic loader is a patented mechanism and consists of a bin holding exactly a tramcar load placed just over the tracks. The bin has a bottom discharge gate held in place by a latch that is tripped by the car as it approaches.

At the discharge tower the car runs off the track ropes on to fixed semicircular rails so curved as to reverse the car by dropping the forward end and turning it back toward the loading terminal, upside down. As the car turns over, the coal slides into the chute above the railroad tracks.

Army Tests Centrifugal Gun

A SMOKELESS, powderless machine gun, that fires 1200 round bullets a minute, was tested recently by the New York National Guard. The gun is mounted on a one-ton motor-truck with a powerful gasoline engine carried on the rear to generate the power that "fires" the gun.

A heavy flywheel, rotating at high speed, develops enough force to project a bullet which will kill at 2000 yards

Centrifugal force developed by a heavy flywheel rotating at a high rate of speed gives the new gun sufficient range and penetration to kill at 2000 yards. From the magagine the bullets pass in unbroken stream through a tube leading to the center of the disk. From this point they drop into grooves on the face of the flywheel, through which they slide to the circumference, and are thrown out through an open slit at a velocity of over 1000 feet a second.

The gun is elevated and trained by worm gears similar to those used on big naval guns, for the whirling wheel acts as a gyroscope, and makes it impossible to aim by hand. Allowing for the difference in muzzle velocity, the shooting is as accurate as that of a machine gun using cartridges.

Photographs © Keystone

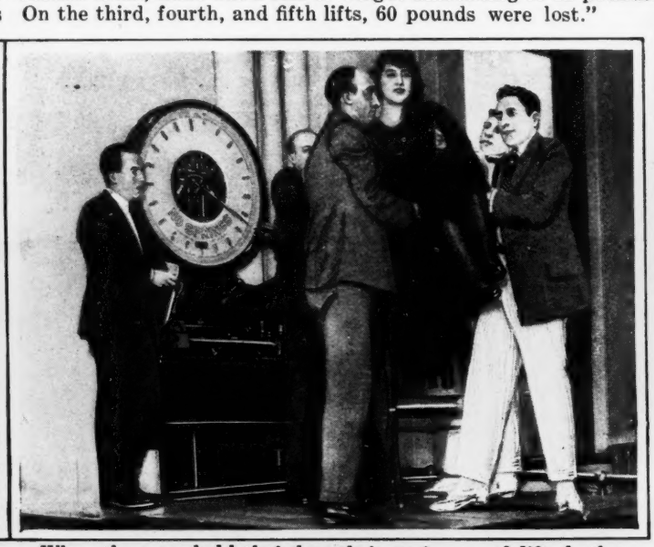
The gasoline motor that generates power to "fire" the gun, is mounted on the rear of a one-ton truck

Weight Vanishes—Can Breathing Exercises Overcome Gravity?

SIXTY pounds of human weight suddenly and mysteriously vanished the other day. Where did it go?

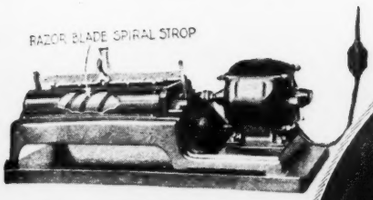
Nearly every one is familiar with the lifting game in which four persons, after breathing deeply in unison, lift a fifth person easily with their finger-tips. The lifters always agree that the subject seems to have lost weight. Does the subject actually lose weight, or is it an illusion? To seek the answer, five persons recently tried the experiment on the platform of a sensitive scale. At the outset the combined weight of the experimenters was 712 pounds, but when the lift was made, according to Hereward Carrington, Ph.D., research officer of the American Psychical Institute, "these surprising results were noted: On the first and second trials, there was a loss of weight amounting to 52 pounds. On the third, fourth, and fifth lifts, 60 pounds were lost."

The combined weight of the experimenters as the four men placed their finger-tips under the subject, was 712 pounds

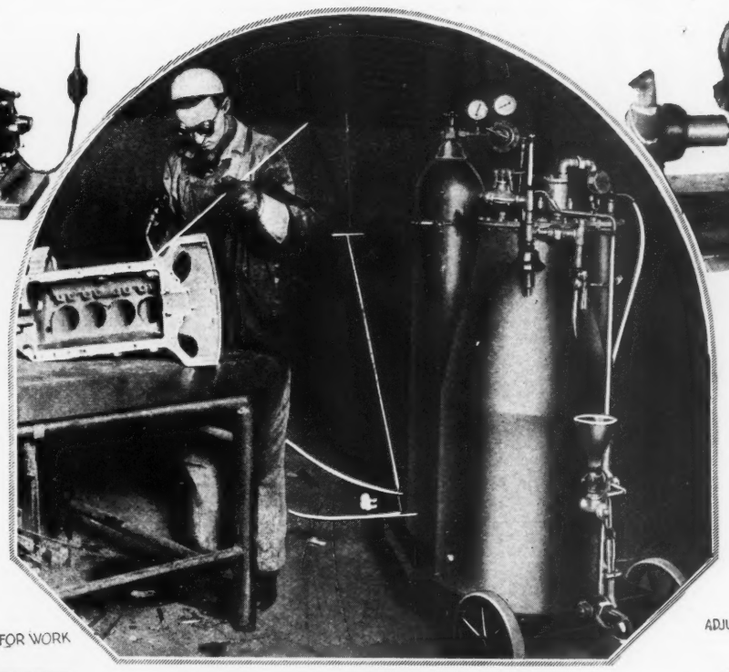


When the men held their breath in unison and lifted, the scale indicator dropped from 712 to 652 pounds

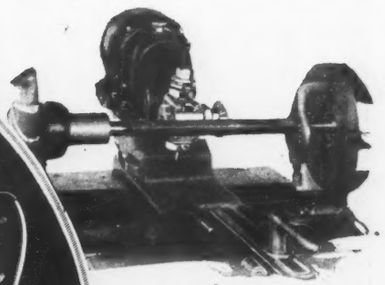
New Machines and Tools to Turn Out Better Work



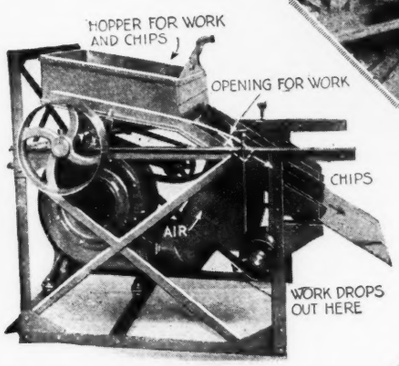
Safety-razor blades of any type may be sharpened at the rate of 250 an hour on this motor-driven spiral grinder. The blades may be placed in the holder while the machine is running



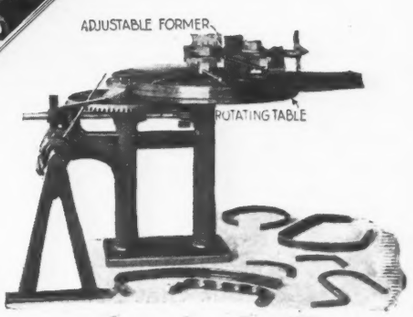
When the torch is lighted, the feeding mechanism of this acetylene generator automatically begins to generate gas. When the torch is extinguished, the mechanism automatically stops and the generation of gas ceases simultaneously



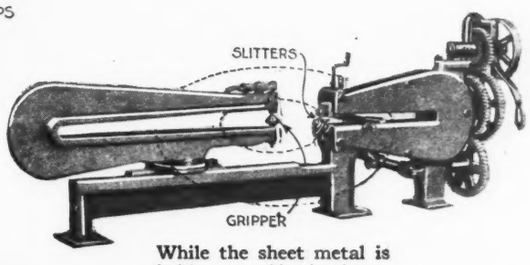
This machine will mill, flute, and grind a tap in one setting, will mill worms, cut gears and ratchets, and can also be used for drilling jigs and fixtures and for splining shafts



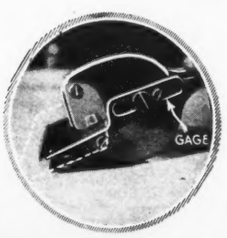
This pneumatic separator is used for separating chips from screws and other small machine products. One man can handle it, doing as much work as three men using riddles or six picking by hand



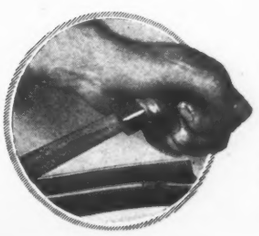
With this bending machine nearly every kind of iron or brass stock, like angles, channels, tees, rounds, square, square twisted, special sections and flat bars on edge, may be bent any shape desired



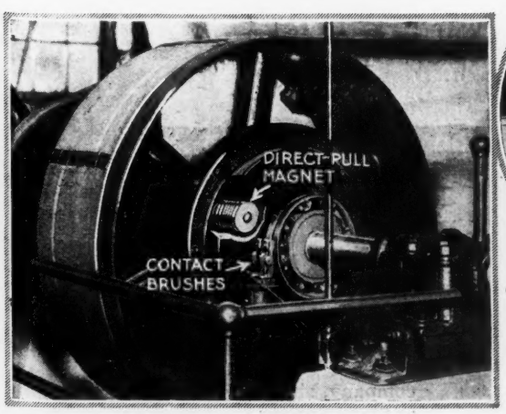
While the sheet metal is held centered in the throat of the holder by an eccentric device, it is fed against the cutting disks of the shearing machine, which will cut circles or rings



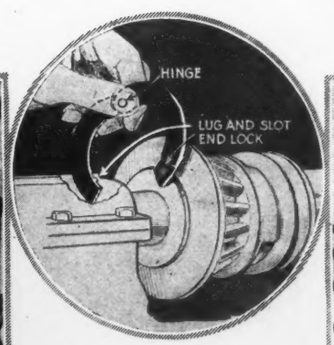
Tinners or others doing light metal work will find the hand punch at the right a valuable addition to their kit of tools. It has a gage for measuring the distance of holes from the edge



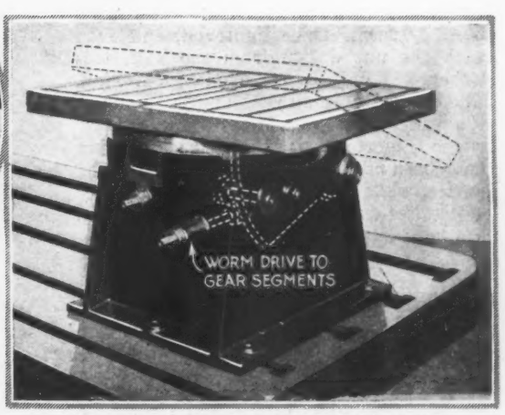
Here is a file-holder consisting of a rubber cap that will fit over the end of the file and will protect the hand of the mechanic while doing hard work with the rough-cutting tool



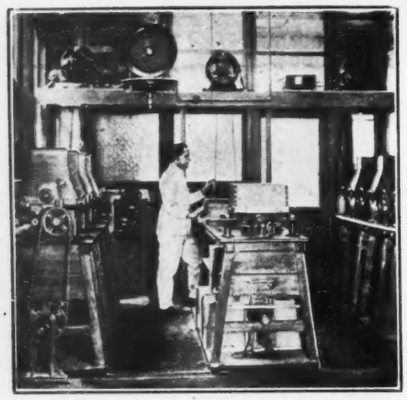
A new direct-pull magnetic clutch controls the operation of any belt-driven machine by a switch that engages or disengages the clutch



The hinged washer can be placed in position on the shaft of an engine or the axle of a motor without dismantling the machinery A new washer may be put in place in a few minutes. It is made of brass or steel



Work fastened to the plate of this tilting and rotary table may be machined on five sides and at any angle with a single setting up



Miniature Flour-Mill Tests Wheat Varieties

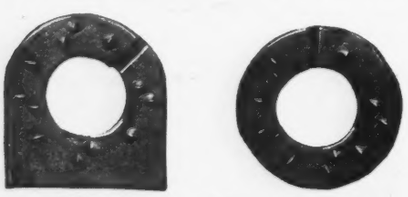
SAMPLE varieties of wheat from all parts of the world are tested in the laboratories of the Department of Agriculture at Washington by a perfectly equipped miniature flour-mill. Each sample is cleaned, scoured, tempered, ground, bolted, and finally baked in an electric oven.

After baking, the weight, volume, color, and texture of the bread are studied, and a record made for the sample of wheat used. All the samples are treated alike in milling, mixing, and baking, so that there is no chance for error in making the comparisons.

The illustration shows both the roll and sifter sections of the mill. It is part of the equipment of the Bureau of Markets, and its principal use is to verify data for the preparation and revision of Federal grain standards.

A Locknut that Prevents Spreading Rails

A WASHER that prevents nuts and bolts in railroad fish-plates from slipping means a great saving in lives. Neither vibration nor climatic conditions can loosen the grip of a new lock-washer, which has a spurred side that rests next to the plate and a smooth lock side that has



Vibration cannot loosen its grip

so much spring to it that the nut cannot possibly turn. Once tightened, and even with the nut drawn from the bolt, this washer can only be removed by chiseling. The invention is already in use on one of the principal railways of the United States, which reports that fewer track-walkers have been needed since the adoption of the device, while at the same time the danger of disaster due to loose and spreading rails has been lessened.

EXPERIMENTS made in Germany indicate that the enrichment of the atmosphere with carbon-dioxide gas has a decidedly stimulating influence upon the growth and fertility of plants. It was found that plants not only grow more rapidly and vigorously in air surcharged with this gas, but that they produce crops from two to three times more bountiful than plants under normal atmospheric conditions.

Field-Glasses Are Worn Like Spectacles at the Races

FOR the convenience of those who follow the races the latest in field-glasses is small and light enough to be mounted on spectacle-frames and worn upon the nose.

The glasses are of good power. Their lenses are adjusted to the eyes in the manner used with the regular field-glass. In fact, these little glasses are regular field-glasses, only their unusually short focal lengths enable the wearer to watch the horses with both hands free. As the glasses are held firmly against the face, it is possible to focus them with great accuracy.

It's easy to watch the race

"Silent Partner" Takes the Place of Dance Instructor

HERE is a practical idea for the use of the self-conscious and awkward young man who is anxious to learn to dance. Get a "silent partner," who is always willing to oblige the learner when the latter is stumbling through the preliminary steps.

The figure is supplied with a set of pivoted arms which may be placed in the proper position and at the proper height for the partner. A freely revolving ball extends from "her" waist to the floor and provides a bearing for the figure. At the waistline in the back is a loop into which the learner places his hand.

This partner can be easily led

Street Lamp Reflector Confines Light to Roadway

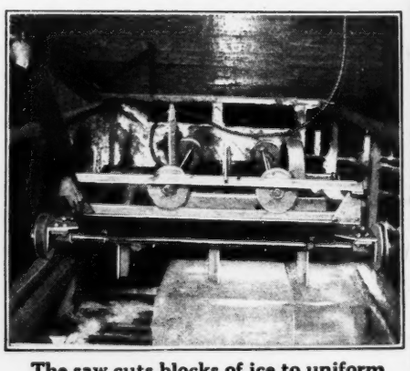
FROM ten to twenty times the illumination possible with reflectors of existing types, and a reduced cost of maintenance are claimed for a longitudinal reflector, which concentrates all the light along the surface of the road. Two flat, polished plates meeting at an angle of about thirty degrees exactly beneath the center of the light cast the light a long distance down the road, and do not waste current lighting lawns and house by the side of the street.

This type of reflector is adopted for lamps that hang over the center of the roadway. As all surfaces are flat and straight, it is easy to clean, and there is nothing complicated to get out of order. A hole at the apex lights the roadway directly under the lamp.

THE spindles of small rotary grinders recently constructed in England and tested by the National Physical Laboratory, have attained the remarkable speed of 45,000 revolutions a minute. The makers expect to increase the speed of their grinding spindles to 100,000 revolutions a minute in the near future.

Electric Ice-Saw Does Work of Eight Men

BY cutting its ice with an electrically driven circular saw mounted on an overhead platform, an ice company in Oklahoma City makes sure that every cake is full weight and of uniform size. Besides giving this service to the customer, the saw has proved a money-maker to the



The saw cuts blocks of ice to uniform sizes, assuring full weight

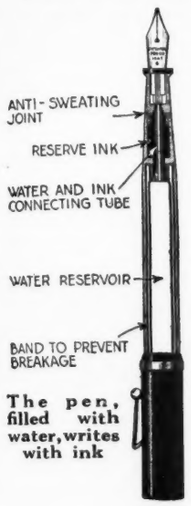
company, since the machine will turn out as many various sized blocks in an hour as eight men could saw by hand.

In spite of the simple appearance of the installation, nearly a year of experimentation was required to perfect it.

Fountain-Pen Holds One Year's Ink Supply

ALTHOUGH no larger than the ordinary fountain-pen, a new invention holds in a tiny chamber enough concentrated ink to last a year. It is filled with water, or tea, or red ink, or whatever else happens to be handy, and five seconds afterward it writes with a jet-black ink that is permanent and waterproof.

A simple, ingenious valve prevents too much concentrated ink from being admitted to the barrel of the pen.



The pen, filled with water, writes with ink

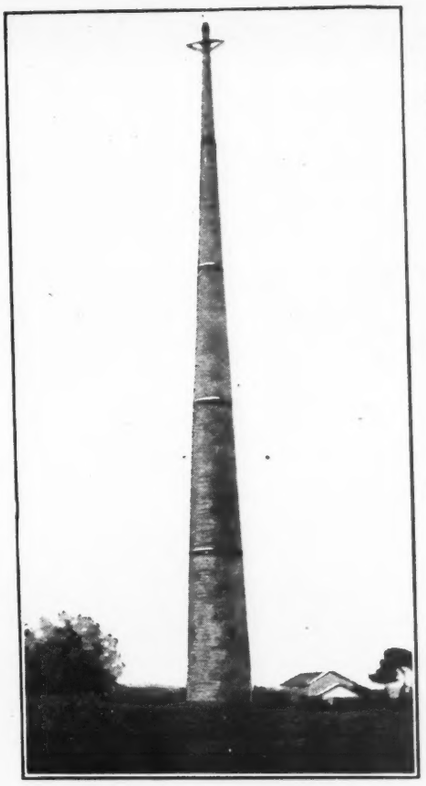
This V-shaped valve is held tightly shut except when the pen has just been filled with water by the self-filling device. To turn this water into ink, the top section is given two turns to the right. This opens the valve very slightly, and when the section is screwed back, a very minute amount of ink paste is squeezed into the water, just enough to make ink of the proper consistency. As the valve is shut, it is impossible for additional paste to leak into the barrel, so the ink never becomes thick and gummy.

You Can Study Anywhere with New Book-Holder

WITH an attachment which slips onto the back cover of a text-book and holds a syllabus or notebook above the volume in a convenient position for reference, a student can work anywhere. The "third hand" makes the use of a table or a desk unnecessary, and permits one to study out of doors without using stones to keep his papers from blowing away.

The device consists of a thin piece of spring metal with an oxidized copper finish, and may be used on both stiff and limp covered books.

OWING to the lack of railroads, the bulk of traffic in French Morocco is handled by 3½- and 5-ton motor-trucks. The trucks need a cooling system larger and more efficient than the usual model, because of the high desert temperatures encountered.



Japan Has Largest Concrete Mast in the World

A RADIO mast 664 feet tall, constructed of reenforced concrete, has been erected at Havanomachi, Japan. The tower is about fifty-five feet wide at the bottom and five feet at the top. The thickness of the concrete walls, which are heavily reenforced with steel rods, varies from about three feet at the base to approximately five inches at the summit.

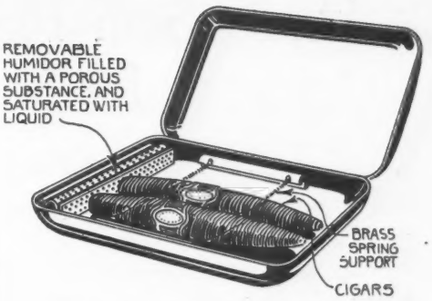
This unusual tower was built with full knowledge of the earthquakes to which certain sections of Japan are subjected and the engineers feel certain that the mast will weather any ordinary seismic disturbance.

Accurate tests were made of the effect of heavy winds on the completed tower and it was found that the period of vibration was much greater than that of the earth, which varies from 1 to 1.2 a second.

Small Wrench Tightens Spokes of Bicycle Wheel

BICYCLE spokes that become loose need no longer remain an annoyance or require the attention of a mechanic. A small spoke-tightener is on the market that is so simple and so well designed that a boy can manipulate it with the thumb and finger. The spoke fits in a groove while the little wrench-head does the work.

A boy can easily tighten the spokes



Pocket Humidor Keeps Cigars in Perfect Condition

AN aluminum cigar-case equipped with delicate brass coil-springs inside, to hold the cigars in place, makes up a new pocket humidor for the smoker. In one end of the case a small compartment is filled with a porous substance saturated with a liquid. The vapor from the liquid is exuded in sufficient quantity to moisten the "smokes" within the case. This compartment is so arranged that it may be removed to recharge it with the liquid.

In a recent test of the case, cigars were dried by furnace heat for about three days, until the wrappers were brittle and flaky. They were then placed in the humidor, and in a few hours are said to have regained all their good smoking qualities.

Special Gas-Mask Perfected for Carbon Monoxide

BY using a mixture of metallic oxides called hopcalite, and adding a timer so that the wearer is warned when the chemicals are becoming exhausted, a group of American scientists have perfected a gas-mask that will afford complete protection against carbon monoxide. This gas is the most dangerous and insidious of industrial poison gases, since it is present in many operations and, being tasteless, colorless, and odorless, gives no warning of its presence.

The mask consists of a face piece of improved design, with a double canister and a timer. This last mentioned mechanism is actuated by each inhalation, and by means of a dial and pointer that show how long the chemicals will continue to absorb the gases. The dial is marked in quarters, and the second canister should be slipped into the breathing-tube before the first is exhausted. The action of the timer is declared to be positive.

Complete, the mask weighs six pounds.

A SUBSTITUTE for bone-black has been discovered after sixteen years of patient research by industrial chemists.

Uncle Sam Plans Storage Vaults in Old Mines for Precious Supply of Helium

Sufficient Non-Inflammable Gas to Fill Eight Airships Like the ZR2 Held as Practical Monopoly by This Country

By Ernest L. Jones

THE storage of helium under high pressure in abandoned mines is a plan lately worked out in detail by army and navy experts in Washington, who believe that by this method Uncle Sam could make profitable use of his existing monopoly of this non-inflammable gas for airships.

The United States has on hand about 20,000,000 cubic feet of helium gas, valued at $2,000,000 and sufficient to fill eight airships the size of the late ZR2. The handling of this gas in 100,000 steel cylinders is awkward and expensive. Considerable interest therefore attaches to the mine-storage plan of the army and navy "Joint Board of Aeronautic Cognizance."

Under this project, use can be made of worked-out mines in all parts of the country, or new tunnels can be driven in suitable rock.

In old mine workings, drifts would be lined with concrete blown on the face of the rock to obtain a smooth surface on which to deposit copper, either in sheets or by means of spraying systems. The gas would be pumped into these chambers under pressure. The copper sheeting is for the purpose of preventing gas losses. Manholes would be provided for each chamber.

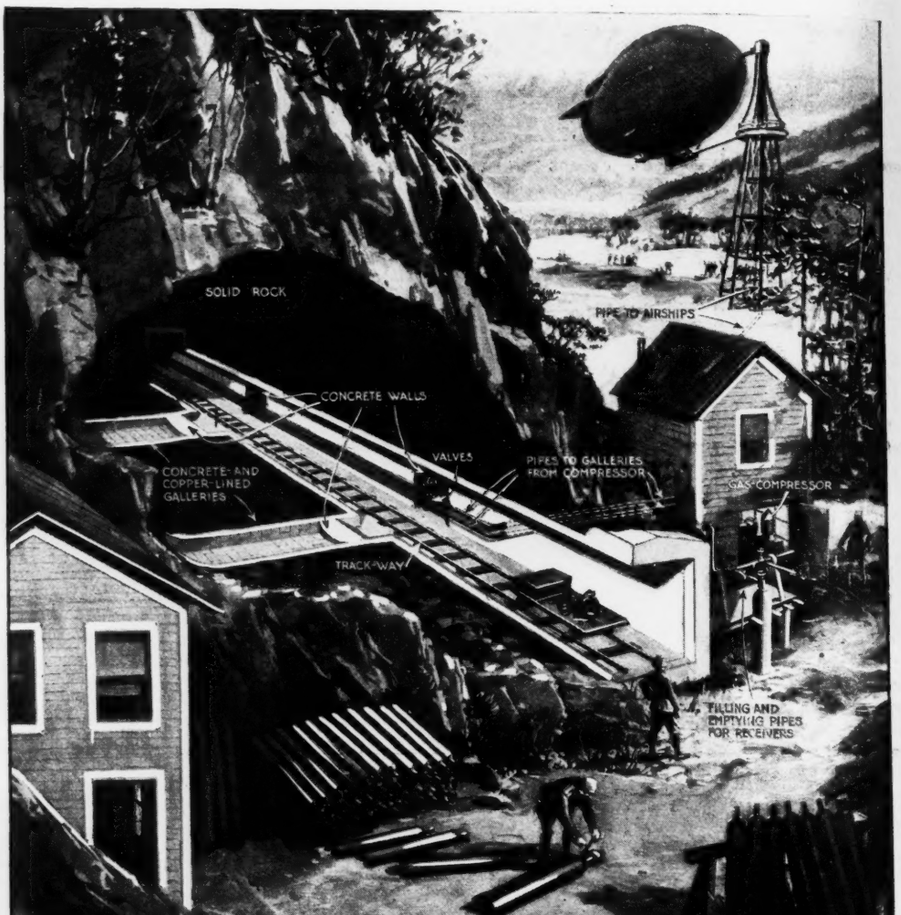
The Lightest Gas Known

Not only is helium the lightest gas known, next to hydrogen, but it diffuses through rubber fabric at only 65 per cent the rate of hydrogen. Only in Canada and the United States has it been found to exist in natural gas fields. The percentage of helium gas in natural gas is not more than 1.84 per cent, and usually less than 1 per cent.

After the wreck of a Zeppelin in 1910, a German proposed that helium be used to avoid similar accidents in the future. British and United States experts also joined in urging the importance of helium as a munition of war.

This resulted in the erection of three experimental plants in Texas, each using a different process for the extraction of helium. The main system employed was to extract by refrigeration the helium from the natural gas as it came from the wells and then pass the natural gas along to the public mains. The elimination of helium actually added to the value of the treated gas, for it no longer contained one of the non-inflammable elements.

Investigation of the wells from which this gas came, developed that there was present a high percentage of helium. The investigators were told of other wells in the vicinity whose gas was of such poor quality that it would not burn at all. Tests of these wells indicated the highest percentage of helium known. Unfortunately, these wells had been allowed for five years to spout nearly 10,000,000 cubic feet of high-percentage helium-bearing gas. They were nearly exhausted and this enormous supply of invaluable gas wealth was completely lost.



This broken-away view illustrates the method of adapting an old mine for gas-storage purposes. In the concrete-sprayed and copper-lined shafts and galleries of the mine the gas is stored under a pressure of 200 or 300 pounds. From the hermetically sealed mine the helium is conducted through pipes to the compressor, where the steel tanks are charged under a pressure reaching 2000 pounds. A direct line for filling the balloons runs from the mine to the mooring station near by

The American plants Nos. 1 and 2 produced some 210,000 cubic feet, reprocessed to 93 per cent pure. Of this, 147,000 cubic feet were at the docks awaiting shipment to France when the armistice was declared.

Cost Is Greatly Reduced

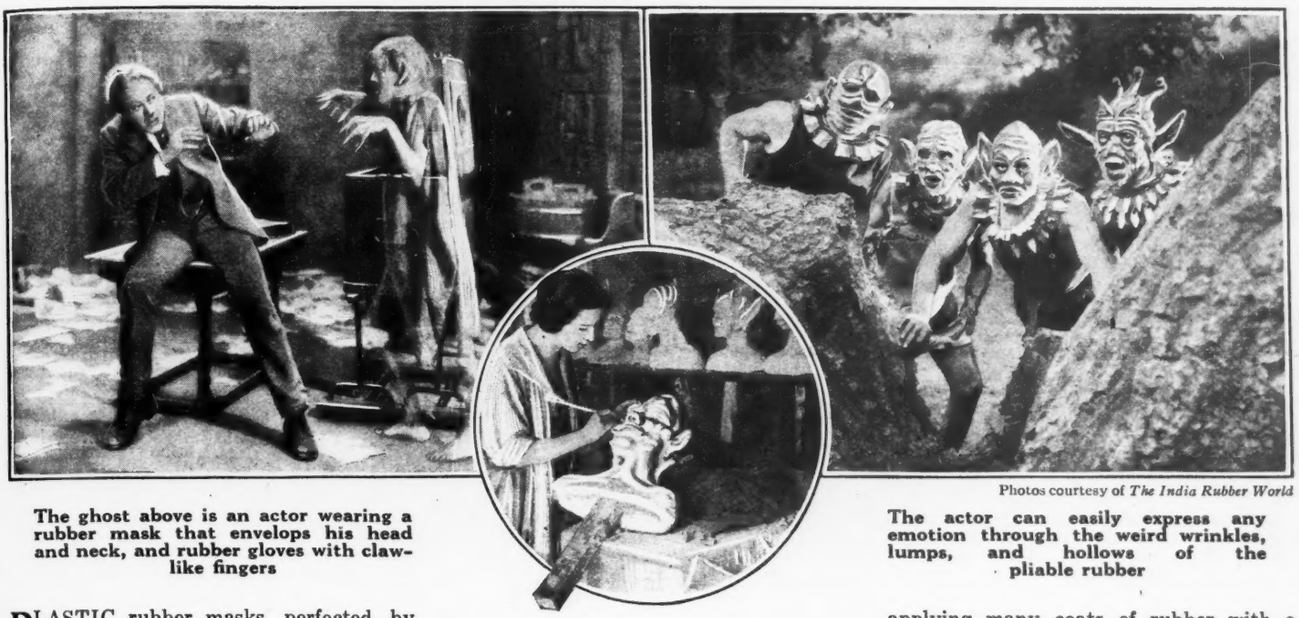
In January, 1919, these two plants were closed. In the No. 3 plant, which did not produce any helium during the war, many changes were made during the two following years and helium is now being produced with the plant at reduced capacity, at the rate of 40,000 cubic feet daily, at a cost of about $30 a thousand. This cost is expected to be reduced eventually to $20. Before the erection of these plants, this gas cost, experimentally, $170,000 a thousand cubic feet.

To separate helium gas from natural gas, it is necessary to liquefy everything except the helium. The helium gas thus obtained is about 70 per cent pure and is then processed over again to obtain a purity of 90 per cent or over.

The army air service has built a mobile repurification unit, mounted on two railway-cars. One car contains a power plant for generating the necessary electric current, and the other holds compressors and refrigeration apparatus for the repurification itself of the gas from balloons and airships when deterioration has reached a certain percentage.

The use of helium in war insures against the burning of observation balloons by the machine-gun fire of enemy airplanes. The only battle losses of the American aerostation service in the World War were due to the burning of balloons by the enemy. The commercial possibilities are obviously likely to change the public attitude toward lighter-than-air craft and work a drastic cut in rates of insurance. The use of helium may also effect a radical change in the propulsion system of airships.

Rubber Masks for Actors Put Life into Movie Ghosts



Photos courtesy of *The India Rubber World*

The ghost above is an actor wearing a rubber mask that envelops his head and neck, and rubber gloves with claw-like fingers

The first step in making a mask is to model a head, which is then dipped in rubber cement

The actor can easily express any emotion through the weird wrinkles, lumps, and hollows of the pliable rubber

PLASTIC rubber masks, perfected by Alex Hall, a sculptor of Los Angeles, California, give life to the grotesque features of fauns and ghosts in the movies. The rubber masks are more realistic than a face built up of grease and theatrical putty; and as the weird lumps and hollows never slip or melt in hot weather, the actor can laugh, cry, or engage in the most violent scenes without danger of "spoiling" his face.

In manufacturing the masks, the first step is to model a head out of plaster of Paris. This form is then coated with shellac, and finally dipped several times into a bath of pure rubber cement, which adheres to the model in a thin coat. When the cement is dry, the mask is stripped from the form, reversed, and the ridges filled in with tire dough. Where much distension is desired, the rubber is made in two third sections that can be inflated with air.

Puffed cheeks are formed by repeatedly dipping these parts in the bath, or by applying many coats of rubber with a brush. Rolls of flesh about the neck are obtained by cotton padding over which the rubber stretches. The mask is so thin and the rubber clings so closely to the skin of the face that the actor can still express his emotions through it. Even the rubber eyelids of the mask adhere to the actor's eyelids.

While most of the masks made thus far have been grotesque, the manufacturers are planning to branch out into a wider field and to make masks of educational value, by producing replicas of sculptured masterpieces from art museums.

"Lumber Mine" Uncovered on Lake Bottom

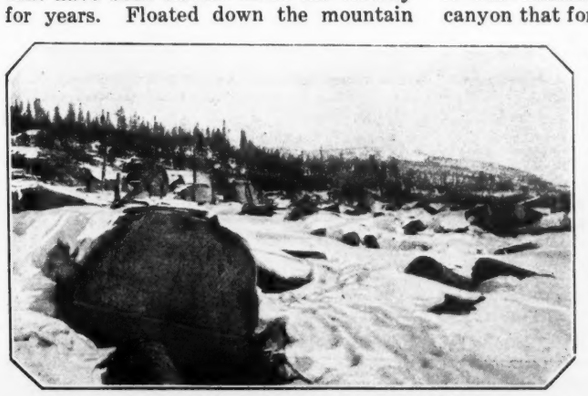
A FORTUNE in lumber, lying at the bottom of a mountain lake in the high Sierras of southern California, was uncovered recently when a power company, building a hydroelectric plant, drained the lake. Three million feet of heavy, sugar-pine logs were found resting on the lake bed, which thus had become a veritable "lumber mine."

The resinous pine-logs were well preserved, although they had been submerged for years

The logs were deposited from time to time in the course of lumbering operations that have been carried on in the vicinity for years. Floated down the mountain streams and intended for sawmills on the shore of the lake, these logs became water-soaked and eventually sank. The sugar pine, which is very resinous, was preserved by the cold mountain water and did not deteriorate to any great extent, even though submerged from one to 12 years.

The rich deposit was uncovered by engineers in charge of constructing the hydroelectric plant. In their preliminary work it was necessary to dynamite a narrow canyon that formed the outlet of the lake, in order to build a dam. Their plan had been to drain the lake, erect the dam, and then allow the lake to fill up again with water from the mountain streams and melted snow.

But the discovery of the "lumber mine" temporarily changed the plan. The power company erected a sawmill on the lake bottom, and now this mill is converting the "deadhead" logs into boards. Meanwhile construction of the power plant waits until the work of salvage is completed.



Draining of the lake revealed hundreds of logs, now being salvaged by a sawmill built on the lake bottom

"Bomb Squad" Armor Stops Bullets at Two Feet

STAGGERING slightly as the steel-jacketed bullet from an army automatic pistol flattened itself against his chest, Albert Schwarz, of New York City, proved dramatically at a recent demonstration that the reason he had been able to sell ten suits of his patented body armor to the police force was that it would check a bullet fired from less than two feet.

The armor is built of overlapping strips of spring steel about eight inches long, two and a half inches wide, and one sixteenth of an inch thick. The strips are held in pockets in the canvas jacket, and lapped so there are four thicknesses of canvas and two pieces of steel covering every vital part of the body. The cushioning effect of the cloth between the steel gives the armor its strength. The suit weighs 10 pounds.

The armor purchased by the New York police is used by members of the "bomb squad."

© K. & H.

Legless Man Tours in Goat-Cart

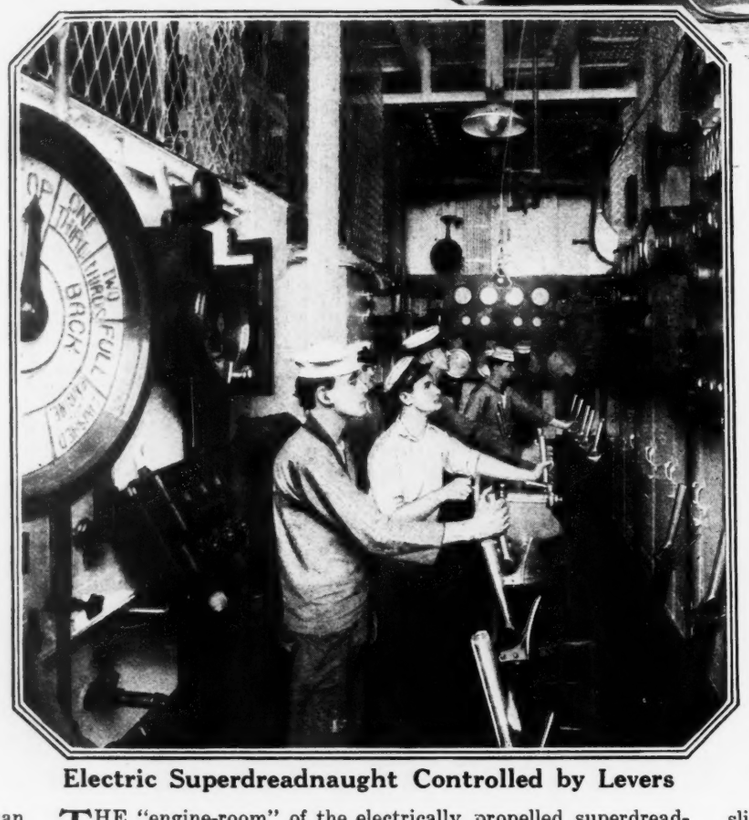
BETTER known as "Overland Jack," John Rose, of Texas, cannot walk a step, but he has traveled 20,000 miles behind his team of goats.

Rose's legs were cut off in a street-car accident in his boyhood, yet in spite of this handicap, every year from April to November he may be found on the open road, driving from town to town selling picture postcards of himself. That buyers are plentiful is shown by the fact that he owns two farms and has a respectable bank account.

The team averages ten miles a day, pulling a 600-pound camping outfit. Rose sleeps in his wagon on the road. To get in, he grasps the top of the wagon bed with one hand, the wheel with the other, then swings his body in. To get out, he simply falls forward and alights on his hands.

He has proved that a man can make his way in the world without even a leg to stand on.

AN automatic valve that will drain auto radiators when the temperature nears the freezing-point has been invented by a French engineer.



Electric Superdreadnaught Controlled by Levers

THE "engine-room" of the electrically propelled superdreadnaught, *Tennessee*, resembles a railroad switch-house. Within a space about 20 feet long by seven feet wide, every movement of the battleship is controlled. The propelling machinery, for example, can be reversed from full speed ahead to full speed astern in less than a minute by pulling a set of levers.

At the extreme left, in the photograph above, is the big dial of the mechanical telegraph, installed for use in an emergency; but ordinarily orders from the bridge are communicated electrically.

Auto Exhaust Is Rat-Killer

A TEXAS automobile owner has discovered a novel method of exterminating rats. First, he closes all doors and windows of an infested building; then he attaches one end of a long tube to the exhaust pipe of his auto, and inserts the other into a small opening in the building. Then he starts the engine of his car, and by allowing it to run with a heavy mixture of oil, produces in an hour or so enough carbon monoxide to suffocate every rat in the building. Care is taken later, of course, to air the building thoroughly.

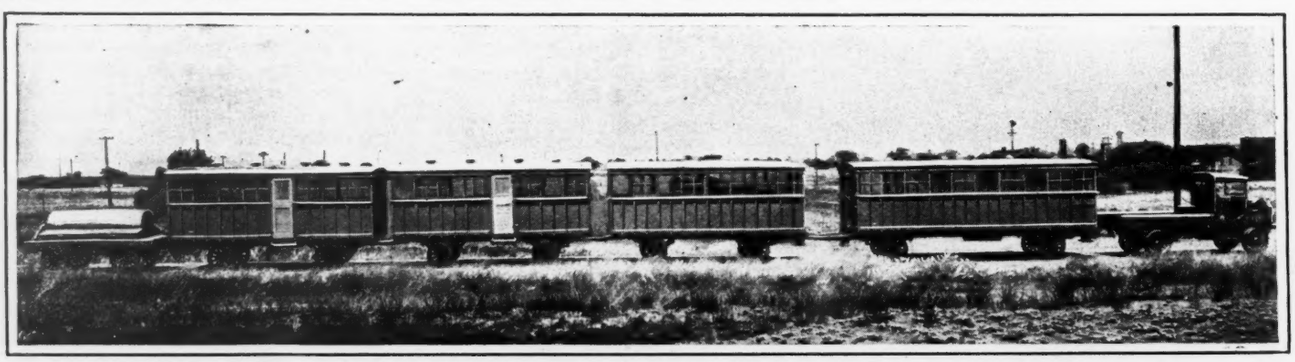
This effective use of exhaust gases in killing rats emphasizes, by the way, the danger of running a car in an enclosed space. Carbon monoxide is colorless and odorless, and gives a person no warning of its presence except a slight headache. It attacks the hemoglobin of red blood corpuscles, forming a chemical compound that makes them unable to absorb oxygen from the air. From prolonged exposure to carbon monoxide, a man may die even after reaching open air.

Motor-Truck Hauls Sleeping-Cars for Telephone Linesmen

LINESMEN stringing telephone wires for one telephone company on the Pacific Coast work in comfort, for their truck pulls a string of light utility trailers that are sleeping-cars, diners, and offices. Even their water supply is carried in a tank-car at the rear. In fact, the crew is wholly independent of permanent living accommodations in the sparsely settled districts where most of the work is done.

The living-train stands by the roadside while the men go out in the truck to the scene of the day's work, returning to take their meals at the horseshoe-shaped lunch-counter.

A second truck train carries all the equipment that linesmen need, such as poles, wire, and tools.



The linesmen's train, hauled over the roads by a motor-truck, includes sleepers, dining-cars, and offices—even a water-tank in the rear. The trailers carry all provisions for the crew

War-Created Invention Factory Runs Full Blast in France, Turning Genius to Peacetime Use

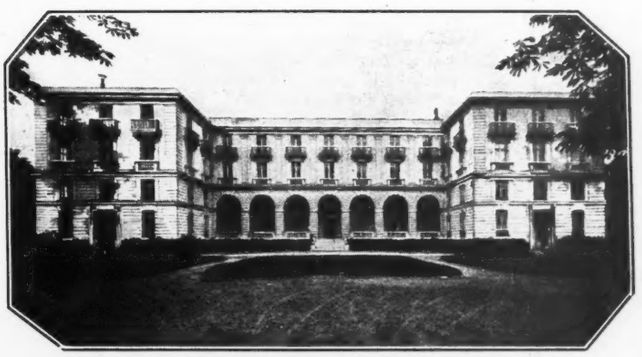
Bellevue Bureau Helps Struggling Inventors Perfect New Ideas

By Ernest Welleck

ON pages 68 and 69 of this issue a number of America's foremost scholars, scientists, and inventors point out the most pressing needs for scientific achievement during 1922. What could be more effective, in realizing these needed achievements, than for the government of the United States to follow the example of France, by establishing a Bureau of Peacetime Inventions to encourage and aid creative genius in perfecting new ideas?

AMONG the nations involved in the great war, France alone retains its war-born Bureau of Inventions to encourage and develop new ideas in peacetime. The success with which this bureau is assisting in scientific and industrial advancement during a period of reconstruction serves as an example that the United States and other nations might profitably follow.

The wartime bureau in France, as in other countries, grew out of stern necessity. At the outbreak of the struggle not one of the powers involved, not even Germany, was prepared for the terrific test that was to come. When the governments began to realize the enormity of the conflict, it became clear to them that to win they would have to mobilize not only their armies, but all the physical and intellectual resources of the nation as well, and would have to strain every effort to bring about thoroughly organized and wisely directed cooperation of all classes and elements.



Above is the main building of the Bureau for Peacetime Inventions at Bellevue, near Paris, where the French government develops the best ideas of inventors for practical use. Here since the war scientists and engineers have studied and tested more than 1500 inventions

In every one of the belligerent countries, specially created governmental branches were given the task of centralizing and coordinating the united efforts of science, industry, and invention.

Thousands of Ideas Studied

France was like the rest in that a bureau of inventions was created at the end of 1915; and later this bureau was placed under the direction of an Under Secretary of State. During the war it examined nearly 50,000 propositions, of which more than 2000 were considered of value and were turned over to the various research sections for further study and elaboration.

Realizing that this body, which was of such great value during the war, would be equally valuable in peacetime, especially during the trying period of post-war reconstruction, the French Chamber of Deputies decided to conserve the existing organization and established the Bureau for Scientific and Industrial Research and Peacetime Inventions, of which M. Breton, the former Under Secretary of State, is the head.

The bureau has a large and well-equipped plant at Bellevue, near Paris, which contains laboratories, workshops, designing- and testing-rooms necessary for the work of the different research departments. With this bureau collaborate all the public and private laboratories of France, those of the universities and technical institutes and the noted centers of independent research, such as the Pasteur Institute and the Eiffel Laboratory.

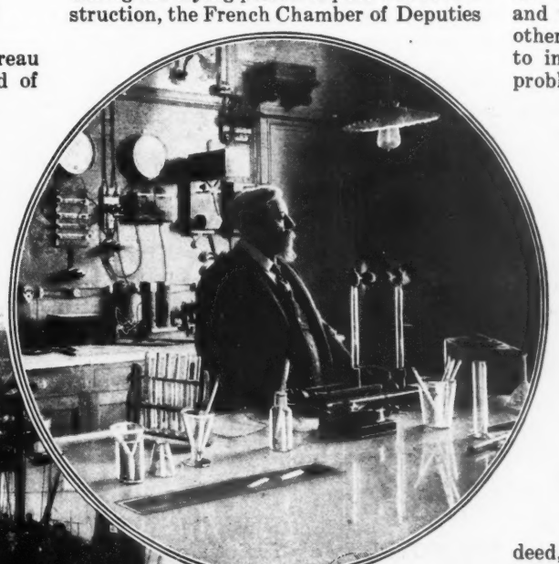
Aid for Inventors

The staff of scientists, engineers, and investigators connected with the bureau devotes its labor to the examination of ideas suggested by inventors and scientists; it tests these ideas and develops their valuable features after thorough research; it elaborates and perfects inventions and aids the inventors with advice and suggestions as to the best methods of practical and profitable utilization of their inventions. Inventors are brought in contact with capitalists and manufacturers able and willing to back them financially and otherwise. The bureau also undertakes to investigate and, if possible, to solve problems that manufacturers may meet in their specific lines of work.

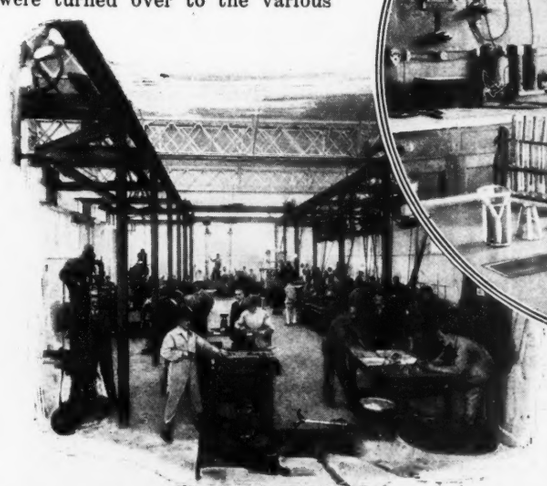
Since the close of the war the bureau has taken up and studied more than 1500 ideas, and many of these have been found to be of practical value. The list includes a number of highly important inventions that contribute materially to scientific and technical advancement and to the industrial progress and prosperity of France.

This record of achievement contains a valuable lesson from which the United States might well profit. America has many excellent and well-equipped research laboratories scattered throughout the country, but they work without adequate cooperation or coordination.

The government maintains, indeed, many scientific and technical research bureaus and laboratories, among them those of the Bureau of Standards, the Bureau of Mines, the Health Department, and the Department of Agriculture, and the Smithsonian Institution. The National Research Council, created during the war, is devoted mainly to important scientific investigations, not to practical inventions, while the Mellon Institute confines its work to industrial chemical research.



M. Breton, former Under Secretary of State for France, has been a leading spirit in successfully promoting the bureau, of which he is the director. The photograph above shows him at work in his private laboratory



The most interesting scene at the bureau headquarters is the busy workshop where models of the inventions are made and mounted

"SOS" Calls by Noted Men for New Year Inventions

Leading Scientists and Engineers Describe Most Pressing World Problems that YOU May Help Them Solve

Low-Speed Landing Is First Need of Aviation

By Orville Wright

Pioneer in aviation

Orville Wright

A MACHINE capable of landing at such low speed as to make landing in small, fenced-in areas safe is the greatest need in practical aviation.

It is well known that this could be accomplished if some method were provided of changing the area of airplane wings while in flight without injuring their efficiency.

On the other hand, some of the advantages of a variable-area wing may be partly secured through more scientific knowledge of air flow about airplane wings, from which it might be possible to design wings of higher efficiency when flying at high speeds and of greater lift, per unit of area, at low speeds, so as to permit of slow landings. Another need is more accurate data for calculating the pressures on airplane wings when moving through the air at high speed.

Inventors Deserve Recognition and Rewards

By Rear-Admiral Bradley A. Fiske

Inventor of the electric range-finder

THE scientific achievement most needed now, in my opinion, is an invention by which inventors will acquire an influence in the world proportional to the benefits they confer. Barring a very few, most inventors have spent their lives in obscurity and poverty. Many a great and beneficent invention has not been taken up until after the patent has expired, with the result that the inventor has received neither money nor the recognition due him.

Rear-Admiral Fiske

Standard Code Language for Nations Is Possibility

By F. G. Cottrell

Chairman of the National Research Council's Committee on International Auxiliary Language, and famous research chemist

I HAVE been tremendously impressed with the possibilities of a new subject that we might call Synthetic Linguistics, *i. e.*, the conscious and systematic application of science to the construction and standardization of linguistic tools.

Stenography and telegraph codes may be considered the first fruits from this field to attain general acceptance. The next step is a standard code language for international needs, such as Esperanto.

THAT every reader may have a bird's-eye view of the goals toward which pioneers in science and invention will be striving during the year, Popular Science Monthly has asked a number of leading men of affairs this question:

"What is the most pressing scientific achievement now required in the field of your special interest and deserving the first attention of American inventive genius during 1922?"

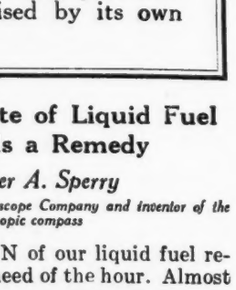
These brief articles indicate, not grandiose schemes for the future, but simply some common-sense steps that we must take if our civilization is to keep pace with problems raised by its own complexity.

Criminal Waste of Liquid Fuel Demands a Remedy

By Elmer A. Sperry

President of the Sperry Gyroscope Company and inventor of the gyroscopic compass

CONSERVATION of our liquid fuel resources is the need of the hour. Almost their entire use is now conducted by methods that are criminally wasteful. Many engineers can get from four to 10 times the power for a given quantity of liquid fuel with equally effective results. The government should join civilian organizations in extending substantial aid, and some such agency as the Research Division of the Engineering Foundation should guide intensive research toward a permanent cure for inexcusable waste.



©U.&U.

Elmer A. Sperry

Head of Preglacial Man Sought

By Henry Fairfield Osborn

President of the American Museum of Natural History

DISCOVERY of fossil remains of Pliocene time is the most pressing scientific achievement in human prehistory. We have proofs of the existence of preglacial man through recent discovery on the east coast of England of flints worked by man and of the use of fire at a period established by geologists as between 3000 and 5000 years ago. The head of this preglacial man is what we most need to find, and especially the brain-case.

Producer Seeks Natural Color for the Movies

By D. W. Griffith

Producer of world-famous motion-pictures

D. W. Griffith

MOTION-PICTURES most urgently need a camera and film that will produce stereoscopic and natural color effects in photography with economical accuracy, the natural color effects to extend with fidelity to scenes involving the most rapid action.

Can Man Discover Ways of Tapping Sun Energy?

By Henry Woodhouse

President of the Aerial League of America

THERE is vital need of finding a solution to the problems created by the diminishing petroleum and coal supplies. The world needs new sources of power, or, better, needs to discover ways of tapping, converting, or harnessing the immense fields of atmospherical, natural energy that envelop the earth and fill the infinite space, as well as the energy radiated by the sun and generated by our earth.

There is evidence that the stars and planets, of which there are over 400,000,000 discernible by our still crude astronomic instruments, are, in effect, gigantic dynamos, each generating vast amounts of energy while speeding through space.

Hudson Bridge Presents New Engineering Problems

By Gustav Lindenthal

Designer of the Hell Gate bridge, and consulting engineer of the Hudson River bridge project

THE largest work in bridge construction ever undertaken will see its birth in 1922. This will be the giant bridge over the Hudson River to connect New York City with New Jersey. Its completion will require five years.

The bridge will be only a part of a gigantic scheme of construction which will include a large union railroad station on each side of the Hudson river.

Engineering science must solve in this project new problems of very deep foundations, of erection of very high steel towers and chains of steel eye-bars that will carry a double platform with 12 railroad tracks on one deck and a wide roadway with surface tracks and promenades, in all 235 feet wide, on the upper deck of the structure.

Behavior of Insulators Still a Pressing Problem

By Charles P. Steinmetz

Electrical wizard

I CONSIDER an understanding of the mechanism of breakdown of solid and liquid insulations under electrical stress to be the most pressing scientific achievement now required in the field of electrical engineering. In the design of electrical apparatus, the part that is responsible for most trouble is the insulation. An insight into the mechanism of breakdown with air as insulation has been given by the work of Peek, Ryan, and Whitehead, so that we can now safely transmit electrical energy at a quarter million volts and have produced and studied voltages above a million. There is evidence to indicate that solid and liquid insulations act quite differently from air insulation under electrical stress, but the mechanism of the breakdown of liquid and solid insulations is still little understood.

C. P. Steinmetz

Psychology Needs More Exact Units of Measure

By Edward L. Thorndike

Director of the Division of Psychology, Institute of Educational Research, Teachers College, New York

IN the field of psychological measurements, the most urgent need is, in my opinion, better knowledge of the units of measure. For example, we now measure intelligence as "a six-year-old intellect," "an eight-year-old intellect," "a ten-year-old intellect," "an average adult intellect," and so forth. Such measures would be far more useful if we knew the magnitude of each and its relation to zero (just not any) intellect. The same is true of almost all psychological measurements.

Who Will Plan Financing of Great Highway System?

By George C. Diehl

President, American Automobile Association

THE appalling economic loss resulting from the operation of 10,000,000 motor vehicles over primitive highways suggests the thought that the greatest scientific achievement of 1922 might be the invention of an equitable plan of financing a system of highways. Extensive economic research must be carried on to determine the relation of vehicles to highways in order that they may render the most efficient service.

Burbank's Work of Improving Plants Is Never Ending

By Luther Burbank

Originator of new fruits and flowers

THE achievement most needed in my line of work, which is the improvement of trees, plants, fruits, flowers, vegetables, and grains, is the development of new varieties that will produce more food, housing, and clothing for the rapidly increasing population of the world at less cost than they are now being produced. During the war my principal work was with wheat, rye, oats, barley, and other grains, but there are so many plants that can be improved indefinitely, that the work is of never-ending importance.

Stable Unit of Value Would Be Service

By David Starr Jordan

Chancellor Emeritus of Leland Stanford, Jr., University

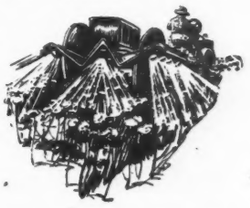
NOTHING I can think of would serve mankind better than the invention of a stable unit of value. The gold standard is thrown into utter confusion by the great war, which has loaded our national coffers with gold, at the same time reducing our aggregate and our individual wealth.

Why Not Kill Boll-Weevil with Ultra-Violet Rays?

By Miller Rees Hutchinson

Engineer and inventor

I KNOW of few more serious menaces with which inventors should cope than the boll-weevil, which destroys annually millions of dollars' worth of our cotton crop. Why doesn't some young fellow with inventive ability and the necessary knowledge get to work on this problem? Just as an offhand suggestion, the possibility of ultra-violet rays being used comes to my mind. We know what they do to germs in drinking water; we know that swimming-pools are purified by a powerful battery of quartz lamps. Why couldn't we devise a means of towing by tractor between the cotton rows a battery of lamps that would be properly screened with lead and that would direct ultra-violet rays on the plants?



Metallurgy Offers Field for Valuable Discovery

By Elwood Haynes

Pioneer in automobile design and in the use of high-speed cutting-steel

IN the realm of high-temperature metallurgy, if some one could discover a refractory that would resist fusion and volatilization at the temperature of melting tungsten, say 3200° or 3300° C., which would be neutral to molten metals, a decided advance could be made in high-temperature experiments. A crystallization of the diamond from molten material at high pressure and temperature is another attractive problem; also the old fascinating problem of obtaining higher thermal efficiency in prime movers.

In higher chemistry and physics is the problem of determining whether the disintegration of the atom is possible in the case of other elements besides radium, actinium, pollonium, etc.

Treasures of the Sea Await Commercial Submarine

By Simon Lake

Inventor, engineer, and a pioneer in the development of the submarine

NOW that the military submarine has proved its value as the greatest defensive weapon, capable of defending any country from invasion by the sea, I expect to see, during the year of 1922, achievements by the commercial submarine that will prove of even greater value to mankind, placing it in the constructive rather than the destructive class. The possibilities are almost limitless.

Water covers three quarters of the earth's surface. The ocean is a great storehouse, rich in natural products of the sea—edible shellfish, pearls, and precious stones; all kinds of minerals and oils and enormous values in sunken ships and their cargoes. Much of this wealth lies in the shallow areas along coasts where commercial submarines of various kinds could operate successfully.

Simon Lake

Motor Industry Seeks More Efficient Use of Fuel

By J. G. Vincent

Vice-president of engineering, Packard Motor Company, and designer of the Liberty engine

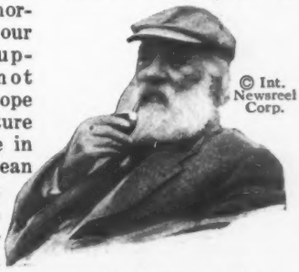
I BELIEVE the most important need of the automotive industry is for a more efficient utilization of fuel in internal-combustion engines. This can be accomplished in several ways, such as practical means for using higher compression pressures without any of the difficulties now encountered; the adaptation of a suitable variable speed transmission to give the engine a better load factor, or a modified Diesel cycle to permit the utilization of heavier liquid fuels.

Alcohol Fuel Is "the Hope of the Future"

By Alexander Graham Bell

Father of the telephone

THE cheap production of alcohol for power purposes and the adaptation of machinery to be run by alcohol, seem to me well worthy of the attention of American inventors. The world's consumption of fuel is so enormous, that our present supplies cannot last. The hope of the future seems to lie in alcohol, a clean and efficient fuel, which can be produced from vegetable matter of almost any kind. All the waste products of our farms and cities are available.



© Int. Newsreel Corp.

Alexander Graham Bell

New Automatic Control Prevents Train Collisions

Electric Relays Operate Brakes without Physical Contact between Engine and Roadbed

EVEN with the engineer dead at the throttle, a train rushing at high speed past a block signal set against it can now be automatically stopped and its passengers saved from disaster, thanks to an invention recently demonstrated at Rochester, N. Y.

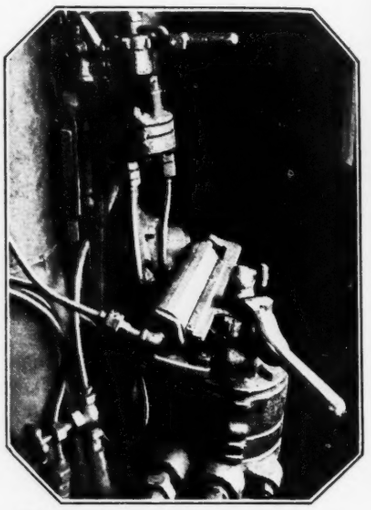
The boxes of electromagnets and relays, one placed between the rails, the other carried just behind the cowcatcher of the locomotive, are used to operate the air-brake. The outstanding merit of the invention is that there is no physical contact between the locomotive and the track element, and that therefore operation is certain in snow, sleet, or rain; while no damage to moving parts is possible.

The track equipment of the apparatus, as successfully tested at Rochester, consists of a laminated iron electromagnet about five inches high and two feet across in the form of a wide, shallow U. At the ends of the U two large pole-pieces extend upward with their tops level with the surface of the rails. The coils of wire on the poles are connected together, and are operated by a relay placed at the side of the track. This relay, in turn, is connected with the block signal system in such a way that if the block is occupied, the circuit to the track device is opened. This puts it in condition to stop a following train. As soon as the block is empty, the circuit closes and the track equipment becomes inactive, so that the following train may proceed without delay.

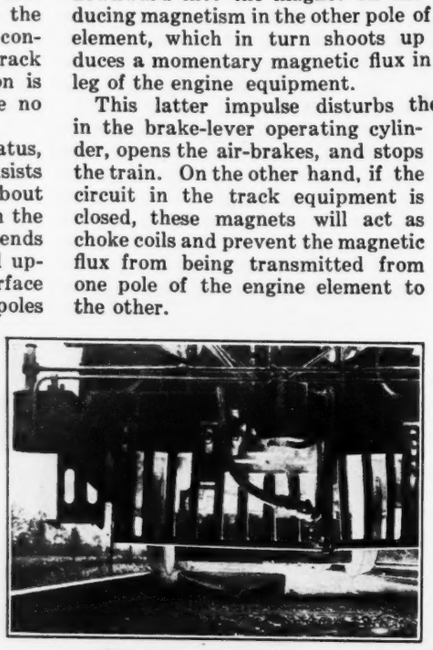
The equipment carried by the engine consists of a storage battery, a "receiving element," and an electromagnet contacting device called an "engine relay." Associated with these is the mechanism for operating the air-brake. The engine receiving element is a U-shaped magnet similar to that on the track, but inverted. One pole is actuated by current from the storage battery, producing a strong magnetic field. The coil on the other end of the U is connected with the battery and the translating apparatus in such fashion as to keep pressure on the brake-lever operating cylinder. Under these conditions the brake lever is free, and may be moved to any position.

However, if this apparatus passes over the track element when "stop" conditions exist, the magnetic field from the engine passes downward into the magnet on the track, inducing magnetism in the other pole of the track element, which in turn shoots up and produces a momentary magnetic flux in the other leg of the engine equipment.

This latter impulse disturbs the balance in the brake-lever operating cylinder, opens the air-brakes, and stops the train. On the other hand, if the circuit in the track equipment is closed, these magnets will act as choke coils and prevent the magnetic flux from being transmitted from one pole of the engine element to the other.



The larger handle is the engineer's brake lever, which is moved automatically to "stop" position



There is no physical contact between the locomotive and the track element. Instead, electric impulses set up by electromagnets are translated into power to operate the air-brake

The position of the track element of the automatic system, in relation to the block signal, is pictured below

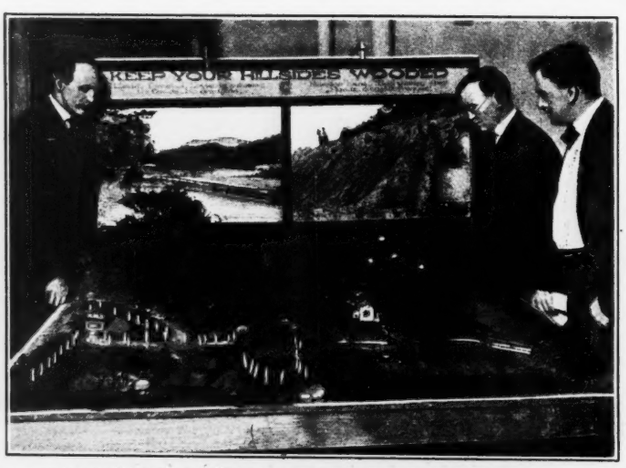
Government Model Shows Causes of Costly Floods and Droughts

TO demonstrate graphically how destruction of the forests means devastation by floods, and that where mountains and hillsides have been stripped of trees and underbrush, floods and droughts will occur periodically, the United States Forest Service is exhibiting an interesting working model in farming communities. In this model rain is imitated by a fine spray falling from two pipes placed above the model.

Two model hillsides are of the same height and the same angle of slope, made of earth taken from one spot; but one hill is covered with moss and ferns, while the other is bare. On a small scale, the moss retains rainfall and prevents erosion just as do trees on mountainsides.

When the imitation rain starts to fall, spectators may see how the soil is washed from the bare hillside. Small gulleys and water-courses soon appear on every slope, while a lake below is never free from mud. Erosion that may take 20 years in reality is reproduced in the model in a few minutes. On the other hand, the model demonstrates that the hillside covered with vegetation is not harmed by the downpour. The water in the lake below this hill is always clear.

To illustrate how eroded land is responsible for droughts, the fall of spray is suddenly stopped. From the barren hillside the flow of water into the lake stops in a very few minutes, while on the moss-covered hill the water held back by the roots of the plants percolates into the lake long after the rain has ceased.



At the left of the picture is Gifford Pinchot, noted conservationist, demonstrating the effect of erosion, caused by denuded hillsides, with the government working model. In the model are two hills, one barren, the other covered with vegetation

Radium Gas Cures Animal Cancer in First Stages

By Dr. George Watson Little
Pioneer in the Treatment of Cancer in Animals

CANCER, the dread disease of humanity, and often found in horses, dogs, and cats, is now being treated successfully by the use of radium emanations.

The curative effects are obtained from gas of radium, which is hermetically sealed in very fine capillary glass tubes that are embedded in the cancer by means of a small needle. In order that the entire cancer may be influenced by the emanation, a tube must be inserted in each square centimeter of growth. During the process of insertion of these tubes, the animal is placed under an anesthetic. Usually in six weeks he is cured.

The needle used for embedding the tubes in the cancer has a hollow barrel. In this barrel a tube is placed and forced out by a stiletto.

The effect of the radium emanation continues for many days—decreasing at a rate of 16 per cent a day. The cancer dies slowly, and if it is not entirely gone in three weeks, a second application of the tubes is given.

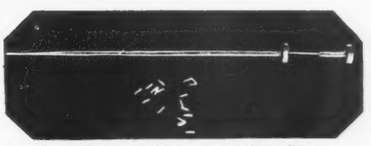
Occasionally it is found necessary to remove a bit of hard or fibrous material, but more often there is no need for surgical interference.

When an animal suffering from a tumor-like swelling is brought to our hospital in New York City, the growth is studied to determine whether it is a harmless or a cancerous tumor. If harmless, it is removed surgically; if cancerous, and not too far advanced, the treatment by radium emanation is applied.

In the case of large animals, it is sometimes necessary to place them on the operating-table and to use chloroform. No animal is treated until a section of the tumor tissue has been removed and a microscopical specimen of its structure obtained. An examination of the tissue is necessary to determine whether it is of a cancerous nature.

The treatment of cancer by means of radium emanations is not attempted where evidence of generalization of the cancer is manifested. If there is more than one tumor, and especially if they are in widely separated parts of the body, we assume that the cells have been transported by the blood from the primary tumor to the secondary growth; and in this case treatment of the original tumor itself would be of no avail. In other words, we do not claim that this radium emanation treatment is a general cure for cancer; it is a cure only in the primary, or first stage. Incidentally, it is this fact that explains the necessity for reporting to a physician at the earliest possible moment any wound which is suspiciously slow in healing, or shows a tendency to grow rapidly.

The animal is anesthetized, and a sealed glass tube of radium gas is inserted in each square centimeter of cancerous growth by means of a needle. The cure usually takes six weeks



A number of the small radium gas tubes may be seen lying beside the needle used in inserting them

CLAIMS that cancer in the primary stage may be cured, without an operation, by the emanations of radium gas, seem to be substantiated by this illuminating article.

If Doctor Little's methods can be successfully applied to human beings, it is more than possible that thousands of the 90,000 cancer sufferers now fated to die each year in the United States will eventually be cured in this fashion.

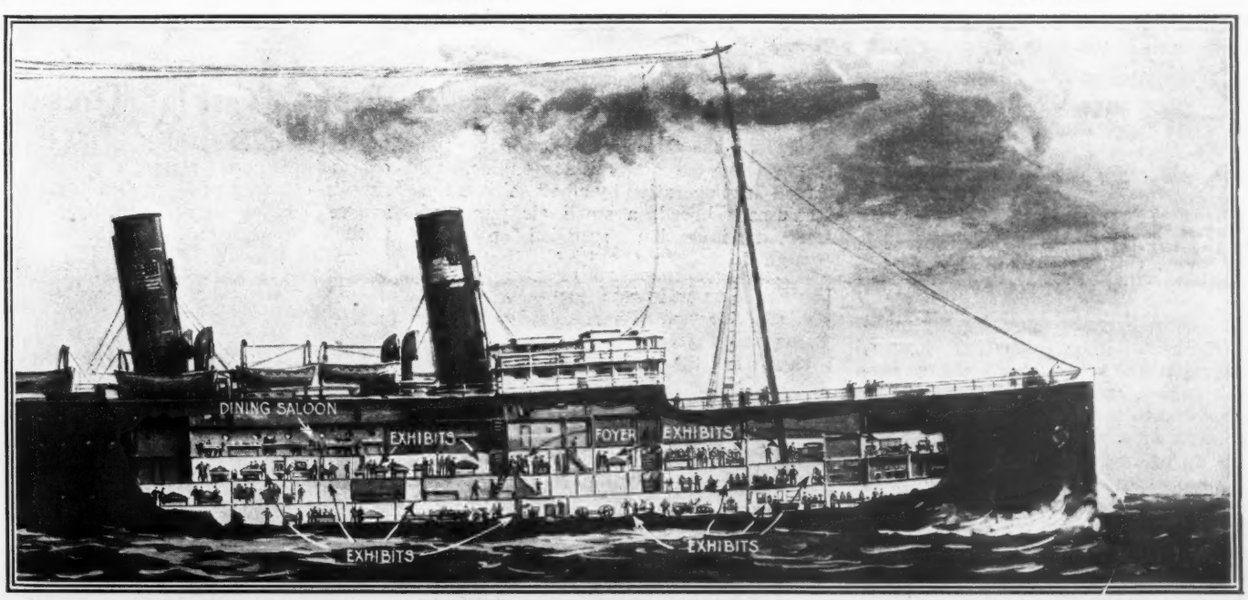
Liner *St. Louis* to Exhibit American Goods to the World

A FLOATING department-store is setting out on a trip around the world to promote the sale of American goods abroad. The reconditioned liner *St. Louis*, once the fastest steamer on the Atlantic, will carry the exhibits of more than 300 American manufacturers to all the important commercial ports, completing her voyage probably within a year.

In preparing the *St. Louis* for her world trade tour, her engines were converted into oil-burners, and she was equipped with every modern device for the comfort and safety of passengers. Space on deck and between decks devoted to exhibition purposes covers about 30,000 square feet. Power is available for all the machinery exhibits.

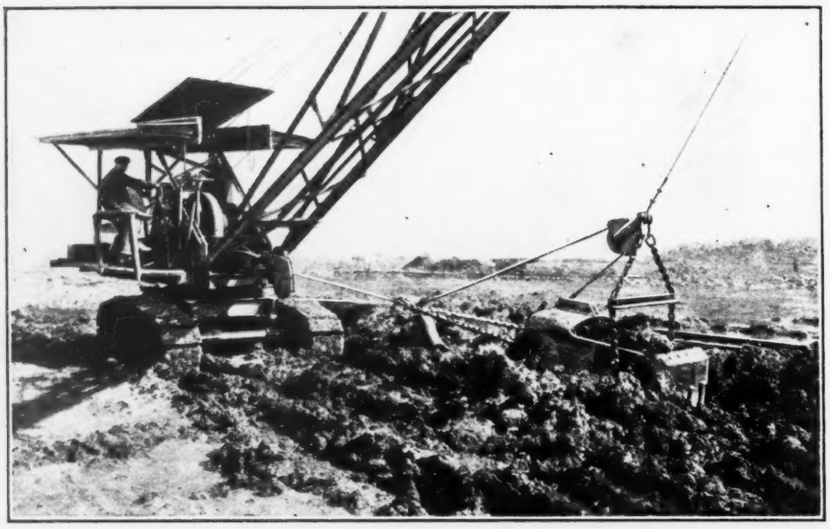
One deck has an uninterrupted exhibition space about 550 feet long. A ventilation system for use in hot countries and a heating system for cold countries are part of the equipment.

The *St. Louis* was the first all-steel American steamship ever built, and is 535 feet long, with a 63-foot beam, and a displacement of 11,600 tons.



This cut-away view of the American steamship "St. Louis" shows the enormous amount of space between decks devoted to the exhibits of more than 300 American manufacturers. The total exhibition space covers 30,000 square feet

Gas-Engine-Driven Crane Lays Its Own Tracks



ILLUSTRATED above is a locomotive crane that is a mechanical handy man. It is capable of a variety of operations. Engineers and contractors have appreciated the service of locomotive cranes in excavating, back-filling, and material handling, but they have been handicapped in its use by the necessity for laying rails and hauling coal and water.

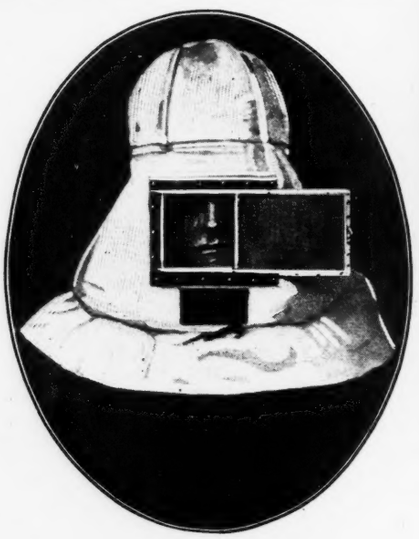
The crane illustrated runs on gasoline and lays its own track. It is of all-steel construction, and is a complete operating unit, requiring no accessory equipment save buckets, hooks, or electromagnets. Its lifting capacity is 3500 pounds throughout a complete circle of 30-foot radius, and will operate on any spot without propping or stabilizing of any kind. Besides its mechanical efficiency, it is inexpensive to operate, since it is run by one man, and even he need not be a licensed engineer, and its light weight permits it to be run over soft ground, and near the edge of trenches and drainage ditches, where hand labor was once thought necessary for excavating and filling.

Screw Cuts Own Thread Under the Blow of a Hammer

THE screw illustrated differs radically from the forms in common use for wood or metal in that it has a very steep spiral thread, scientifically proportioned to have practically the holding power of the low pitch thread of ordinary type, yet capable of running itself down under the blows of a light hammer. Holes must be drilled for it, but no tapping is necessary.

The secret of the screw lies in its design *plus* the special hardening treatment which gives it an ability to cut its own thread in the softer metals, stone, and even in cast iron. The screw has a smooth pilot portion to register it in the hole.

Improved Sand-Blasting Helmet



A REMOVABLE, renewable wire screen for the helmets of sand-blasters greatly improves this equipment, since the helmet itself will have a longer life and it may be easily and quickly cleaned. Men cleaning buildings by the sand-blast method use this mask for face protection.

The wire screen, which must be of very fine mesh to keep out the sand, soon becomes clogged with dust or cut by the flying particles of grit. In this helmet it may be replaced with a new screen or simply taken out and cleaned.

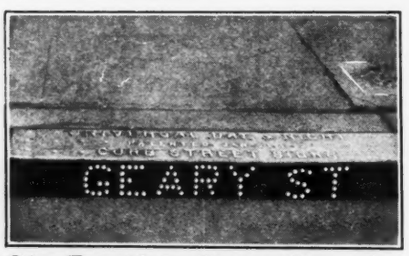
Ringless Piston Saves Wear and Compression Leakage

A DOME-SHAPED piston without rings, recently invented, promises less carbon in the cylinder. Rings have heretofore been considered a necessary evil in pistons, because a certain amount of clearance between the piston and cylinder wall has been considered essential in preventing freezing when the piston expanded.

The new piston has a perfectly smooth outer surface and fits the cylinder so closely that there is only room for a film of oil between the two, but it is claimed there is no danger of seizure because of the novel design of the piston-head. The cylindrical part of the piston is a thin steel shell that is screwed to a cast-iron core.

Naturally the curved cast-iron piston-head becomes hotter than any other part, and therefore expands more, but by making the head either domed or convex, according to the requirements of any particular engine, excessive expansion due to heating causes the head to expand longitudinally. As soon as the edge of the head comes up against the cylinder walls, any additional expansion takes place upward and does no harm. Even if the piston-head is heated to a very high temperature, and is caused to expand excessively, the piston cannot seize, since the edge of the head is so sharply curved that expansion takes place in a longitudinal direction.

At the left is the ordinary piston; at the right, two members of the new dome-shaped ringless piston

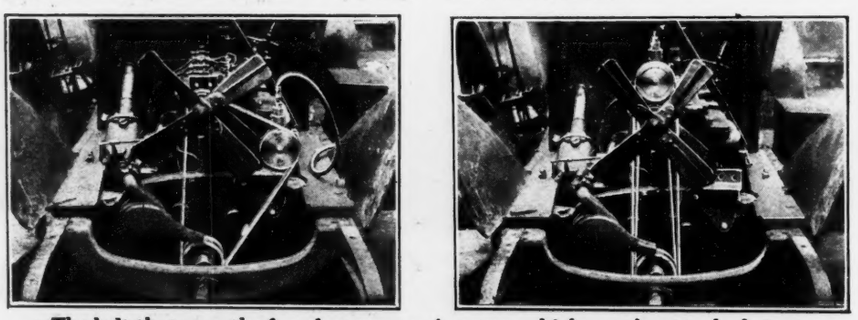


San Francisco Street Signs Are Visible Day and Night

IN the business sections of San Francisco the street signs are built into the curb. They are formed of hollow cast-iron boxes. Small holes punched in the face give the name of the street by day, and a lighted electric light inside the box makes the sign equally visible at night.

Fan Belt Runs an Air Pump for Flat Tires

RUN by the same belt which drives the cooling fan on the auto engine, and thrown into operation by a belt shift on the instrument board, a small air pump of German invention supplied pressure enough to inflate the tires. The pump weighs less than five pounds, but it turns over at 2000 revolutions a minute, and supplies air at a pressure of 150 pounds a square inch. It is permanently attached to the engine or to the engine frame at any convenient location.

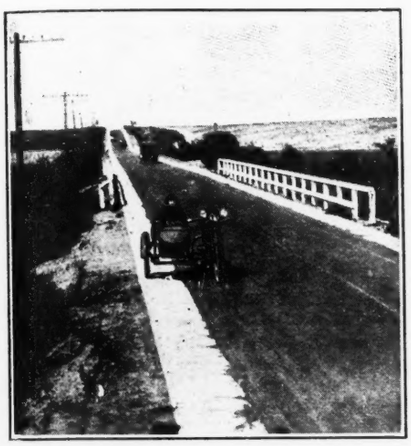


The belt that runs the fan also runs an air pump, which may be attached at any convenient place on the motor block

White Road Border Makes Night Driving Safe

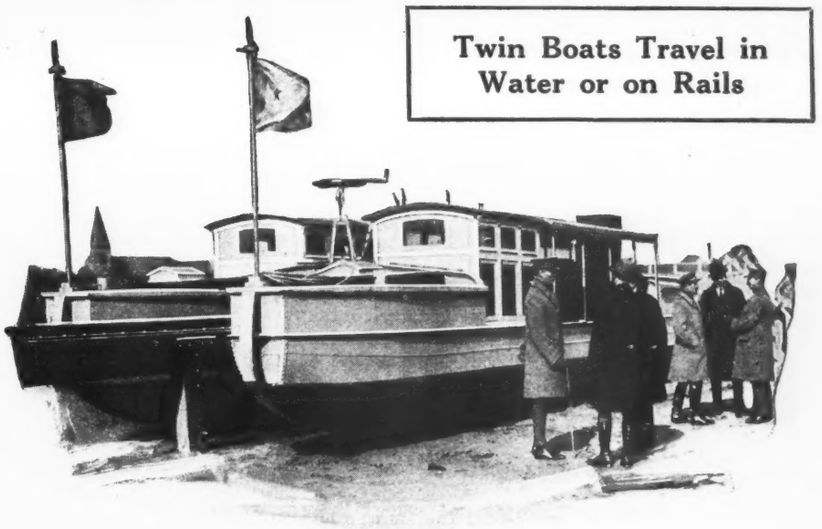
A STRIP of white concrete thirty-six inches wide bordering each side of a California State Highway has greatly reduced the frequency of accidents in night driving. Every one who has driven a car in California knows that the ground often drops off steeply near the edge of the road, and the consequences of running off the road in the darkness are liable to be fatal. The white border, contrasting with the center of the roadway, gives increased visibility and warns drivers in time.

Its installation was an accident. It was decided to widen a number of the highways,



and concrete of a lighter color was used in this work. The border has been found such a simple and efficacious protection against accident that it will probably become a permanent feature.

Twin Boats Travel in Water or on Rails



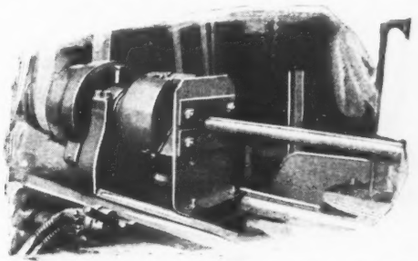
WHEN navigation is impossible on the Congo River, these twin boats leave the water and continue their voyage by rail, under their own power. Invented by a millionaire Belgian named Goldsmith, the feature of the idea is that two shallow-draft steel vessels are firmly bolted together by heavy I-beams, leaving a narrow space between the two hulls for the rail.

In the water they are steered by connecting their rudders to a common steering-wheel, and on land rollers fastened to the center of the connected beams and geared to the engines enable the boats to run along the top of a single rail built along the river bank on short heavy piles.

Boiler-Plate Guard Prevents Chuck Accidents

QUARTER-INCH boiler-plate, reenforced with extra pieces where it is liable to be battered by the shaft, has been used in this shopmade guard to eliminate chuck accidents.

The lathe is used for turning automobile shafts, and the chuck is operated by air without stopping the machine. Formerly the machinist had to be very careful when he inserted the work, lest the jaws of the

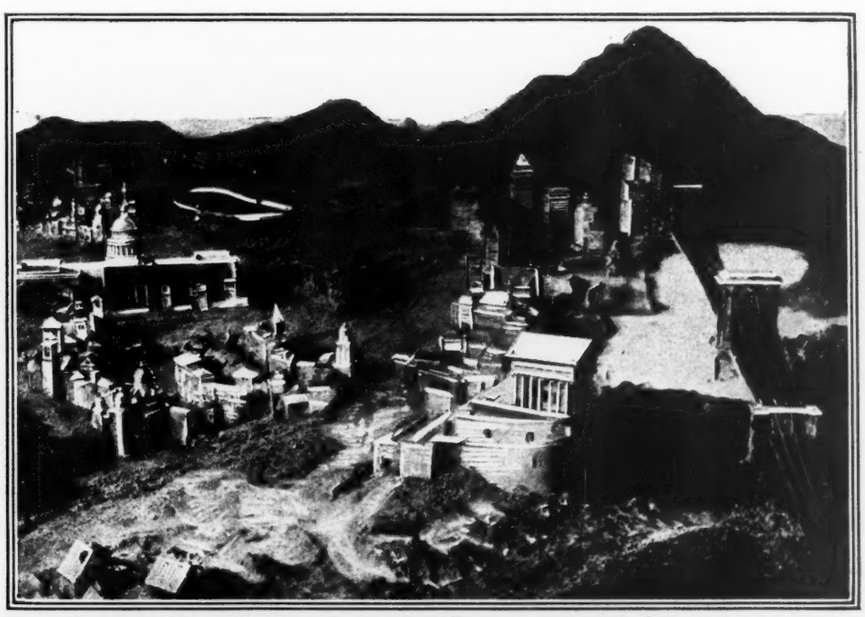


chuck should strike the shaft and knock it from his hands. Since the installation of the guards illustrated, there have been no accidents, and production has increased 15 per cent, owing to greater ease in centering the work.

Berlin Filmland Holds a Miniature World

IN a moving-picture studio in the suburbs of Berlin you can walk from the Pyramids of Egypt to the streets of Tokio *via* London, Rome, and New York in a ten-minute stroll. Permanent sets have been built to provide the correct setting and atmosphere for a picture laid in any part of the world, so that it will never be necessary to send the actors thousands of miles for the proper locations.

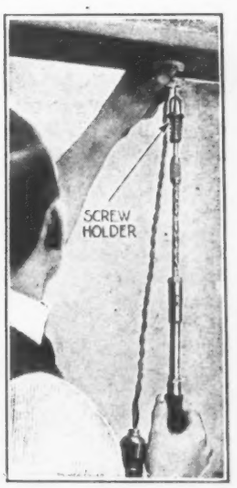
While elaborate sets are a commonplace of the silver sheet, the feature of this German construction is that it is permanent. The buildings will be filmed over and over again in different pictures, so that the initial cost of the undertaking will be distributed over many productions. The illustration shows how the most prominent buildings of the world are located on the "lot." In the background appears a railroad bridge over a river, which is to be used in stunt pictures.



Some of the world's most famous buildings are reproduced in permanent sets in this moving-picture studio in the suburbs of Berlin

Setting Screws with One Hand

A SCREW-DRIVER which has an attachment to hold the screw is especially useful in awkward corners, or where only one hand can be used. The attachment consists of two jaws fastened to the shaft, a ring to limit their spread and a spring to operate the jaws.

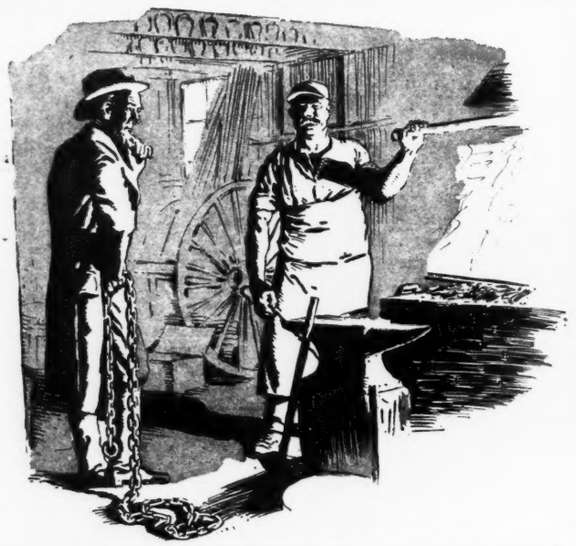


The screw is inserted by using the thumb of the right hand to push up the head. When the thumb is removed, the spring closes the jaws and the screw is held firmly ready for action. The jaws open automatically as the head of the screw touches the surface of the board.

A Knotty Problem Is Perplexing Sam Loyd's Farmer

Should He Pay the Smith to Cut His Chain?

For the best solutions to this and other puzzles on this page, $25 in prizes will be awarded



A FARMER took a length of steel chain, containing 39 links, to the village blacksmith and wanted to know the cost of cutting it into six separate parts, the pieces to consist of 4 links, 5 links, 6 links, 7 links, 8 links, and 9 links, respectively.

The smith told him that to cut a link open would cost 70 cents and to weld it together again would cost 90 cents. Then the farmer rubbed his chin and began to calculate, for he knew he could buy the required six pieces for a cash outlay of $7.50 and turning in the old chain.

The question to settle is: Would the smith's charge for the job, provided he did it with the least possible amount of cutting and welding, amount to more or less than $7.50, the cost of the new pieces?

$25 in Prizes for the Best Sets of Correct Answers

A FIRST prize of $10 will be awarded the reader who sends in the best set of correct answers and analyses covering the three problems on this page; a second prize of $5 for the next best set; and ten other prizes of $1 for the ten next best sets.

Answers must be received not later than March 9, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

By "best" is meant absolute correctness of solution—then, if other points must be considered, clearness of analysis. Mr. Loyd's decision must be considered as final. In case of a tie, each competitor will be awarded the full amount of the prize tied for.

Answers and names of the prize-winners will be published in the June issue.

Prize-Winners in October Brain Test

FIRST PRIZE, TEN DOLLARS: John W. Gamwell, 13 Taconic St., Pittsfield, Mass.
SECOND PRIZE, FIVE DOLLARS: R. J. Stevens, 3610 Cambridge Ave., Rosedale, Kansas

The TEN ONE-DOLLAR PRIZES: Mrs. Caroline B. Boucher, Millington, N. J.; Arthur W. Newell, 409 E. Pine St., Orlando, Fla.; R. A. McNally, Box 38, Altadena, Calif.; C. C. Little, 1534 E. Main St., Galesburg, Ills.; Harry M. Sener, 35 Courtland St., Bridgeport, Conn.; Charles Marti, 7361 Dunedin Ave., Detroit, Mich.; Charles F. May, 215 Heaton St., Hamilton, Ohio; B. V. Buzzetti, Cassville, Mo.; H. C. Hawley, Herington, Kansas; C. E. Farrand, Sumner, Iowa.

HONORABLE MENTION

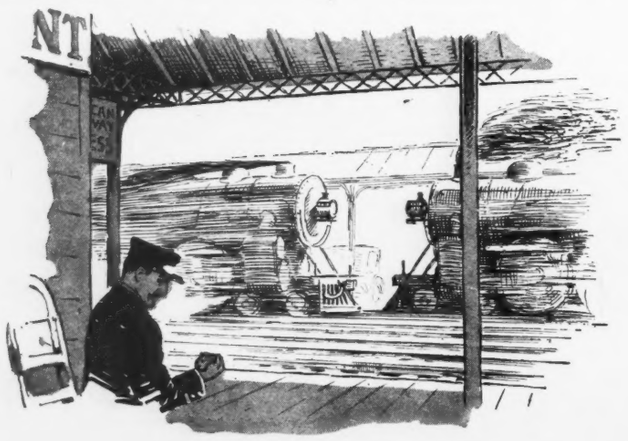
Solvers who are deserving of special commendation for their work in the October contest: Wilmot C. Ball, Baltimore, Md.; Francis O. Burns, Clemens, Mich.; Patrick J. Condon, Brooklyn, N. Y.; P. Charles Stein, Hamilton, Baltimore, Md.; Roy D. Hudson, Marion, Ind.; Fr. Elie, Saint George-sur-Meuse, Belgium; Frank G. Mills, Tacoma, Wash.; Earl H. Loomis, Topeka, Kans.; M. S. Dechert, Cortland, Ohio; M. M. Buck, Muskegon, Mich.; Olaf T. Gylleck, Grand Haven, Mich.; Otis Bryan Cardot, Dunkirk, N. Y.; Warner E. Freure, Georgetown, Ont.; L. H. Abbey, St. Joseph, Mo.; E. A. Pattison, Detroit, Mich.; E. O. Beckett, Canton, Ills.; Leo J. Yetter, Oxford, Mich.; Lionel Dumont, Sherbrooke, Quebec; Geo. A. Volz, Monroe, Mich.; James Anderson, Buffalo, N. Y.; O. H. E. Barschel, Canora, Sask.; E. A. Stoddard, Onaway, Mich.; Denby Clark Stephenson, Augusta, Kans.; Edward E. Sherley, Albany, N. Y.; Arthur J. Macer, Westfield, N. Y.; E. R. Fraser, Sault Ste. Marie, Ont.; L. E. Stibbie, Schenectady, N. Y.; Eric C. Norton, Cambridge, N. Y.; Carl A. Hitchcock, Cicero, Ills.; Mary Sewall, Cambridge, Md.; F. E. Watkins, Toronto, Ont.; Dale Pontius, Columbus, Ohio; E. A. Williamson, Vancouver, B. C.; Benjamin Miller, New Haven, Conn.; Louis Smith, Port Gamble, Wash.; Eugene F. Peckman, Greenock, Pa.; L. Edw. White, Seligman, Ariz.; Paul L. Gross, Muscatine, Iowa; Harry G. Nagel, San Francisco, Cal.; P. H. Coover, Detroit, Mich.; Walter Hunn, Springfield, Ills.; Earl Grout, Okmulgee, Okla.; L. Tappan, Hartford, Conn.; Frank H. Broome, Jersey City Hts., N. J.; P. W. Riemer, S. Boston, Mass.; Wm. Buettner, La Grange, Ills.; John F. Wagner, Royersford, Pa.; Geo. W. Nicholson; Toronto, Ont.; W. L. Brooke, Oakland, Cal.; Eugene H. Breniman, Saratoga, Wyo.; Theodore Winans, Colorado Springs, Colo.; Lieut. Lawrence B. Bixby, University of Chicago, Ills., Charles M. Sandwick, Elmire Heights, N. Y.; H. B. A. Henry, Galveston, Texas; Frank W. Shultis, Lansing, Mich; Lyman S. Rowell, Burlington, Vt.; M. J. Nelson, Willow City, No. Dakota; Lewis G. Steltzer, Harrisburg, Pa.

How Fast Do the Trains Run?

A MATHEMATICALLY inclined station agent who has been observing the habits of the "Limited" and "Local" trains scheduled to pass his post daily, reports as follows:

"One train is 1500 feet long and the other 700 feet long, and they meet and pass in 30 seconds; but when going in the same direction, it takes the faster train 150 seconds to pass the longer one."

Now, assuming that the trains always perform for the agent under full speed, let us figure out the number of miles an hour made by the "Local" and "Limited," respectively.

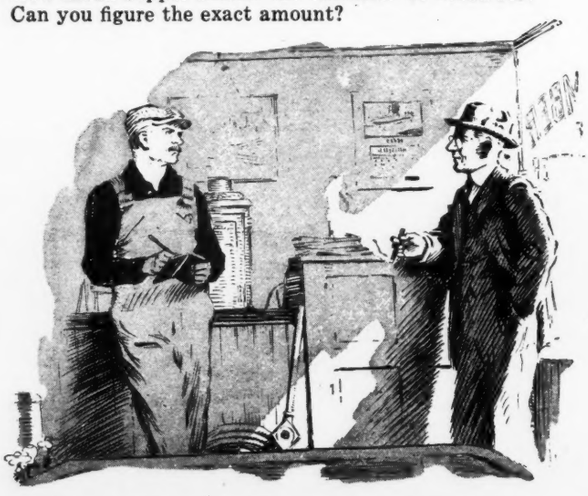


How Much Is the Plumber's Bill?

THE plumber informed a customer that he would charge him 75 cents a square foot for copper to line a tank, the capacity of which was to be 864 cubic feet. The customer ordered him to proceed with the work and to use his own judgment as to the form of the tank, so long as its four sides and bottom were flat, there being no top, and he used the minimum quantity of copper that the job called for.

How much copper should the customer be billed for?

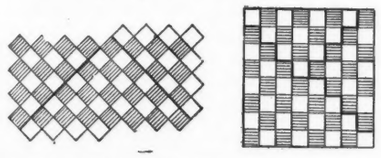
Can you figure the exact amount?



On the opposite page appear the correct answers to Sam Loyd's October puzzles

Here Are Correct Answers to October Puzzles. Were You Right?

"Stumping the Carpenter"



THAT piece of parquetry is made to re-form into a square by dissecting it into three parts, as shown in the diagram above.

"Decode the Radiogram"

THE radiogram is decoded to read: "If a brick balances with two thirds of a brck and two thirds of a pound, then how many pounds does a brick weigh?" Of course, if one third of a brick weighs two thirds of a pound, then a whole brick would weigh two pounds.

The omission of the letter "i" from the second spelling of "brick" added somewhat to the difficulty of deciphering this code radiogram. Many readers succeeded in solving the problem by studying the average frequency of letters.

"How Did He Do It?"

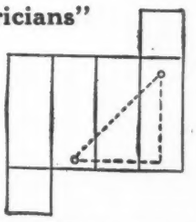
NINE pourings of gasoline were necessary to place two quarts in each pail. Procedure as follows:

1. Fill 4-qt. pail from can *A*. 2. Pour the 4 qts. from 4-qt. pail into 5-qt. pail. 3. Fill 4-qt. pail from can *A*. 4. Pour 1 qt. from 4-qt. pail into 5-qt. pail, filling it and leaving 3 qts. in 4-qt. pail. 5. Empty 5-qt. pail into can *A*. 6. Pour 3 qts. from 4-qt. pail into 5-qt. pail. 7. Fill 4-qt. pail from can *B*. 8. Pour 2 qts. from 4-qt. pail into 5-qt. pail, filling it, and leaving required 2 qts. in 4-qt. pail. 9. Can *A*, lacking 3 qts., is now filled from 5-qt. pail, which leaves required 2 qts. in 5-qt. pail.

Should the first pouring be into 5-qt. pail, the result is obtained in nine pourings, as follows:

1. Fill 5-qt. pail from can *A*. 2. Fill 4-qt. pail from 5-qt. pail, leaving 1 qt. 3. Empty 4-qt. pail into can *A*. 4. Pour the qt. from 5-qt. pail into 4-qt. pail. 5. Fill 5-qt. pail from can *A*. 6. Fill 4-qt. pail from 5-qt. pail, which leaves required 2 qts. in 5-qt. pail. 7. Empty 4-qt. pail into can *A*. 8. Fill 4-qt. pail from can *B*. 9. Fill can *A*, lacking 2 qts., from 4-qt. pail, which leaves required 2 qts. in 4-qt. pail.

"For Electricians"



THE diagram presents the walls, floor, and ceiling of that oddly proportioned hall spread out in one plane. A straight line from buzzer to button, passing across the two end and one side walls, proves to be the hypotenuse of a right angle triangle whose altitude and base are each equal to 24 ft. Solving for the hypotenuse gives the shortest possible stretch of wire, as 33.9411 plus, feet.

Had the hall been of the more rational proportions of 12 feet wide, 12 feet high, and 30 feet long, then the stretch of wire would be found to be a winding course along the two end walls, along one side, and across one end of the floor.

Then the length of wire required would be 41.785 plus, feet (being the square root of 39 sq. plus 15 sq.). This for the information of the many readers who expressed an interest in that hypothesis.

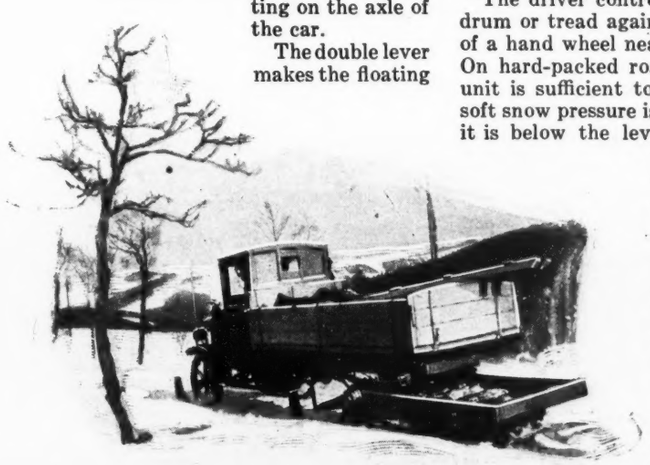
Presto! The Auto Becomes a Sleigh!

WILL sleigh-bells be the next automobile accessories? Standardized equipment of sleds and driving gear, which will convert any auto into a self-propelling sleigh, has been perfected recently in Germany. Transformation of a passenger car or truck for use in heavy snow can be accomplished in two or three hours by the addition of this equipment, since neither the chassis nor the machinery need be changed. The front runners of the sledge fittings are fixed to the hubs of the front wheels. The rear wheels of the car are then removed, and replaced by a double-armed lever with a hub fitting over the axle. On the rear end of this lever is a sprocket-wheel propelling the driving cylinder. This is driven by a chain from another special sprocket-wheel fitting on the axle of the car.

A drum-shaped wheel, biting into the snow, pushes the passenger auto-sleigh

The double lever makes the floating drive extremely flexible, so that the toothed drum that pushes the car is able to conform to any irregularities in the surface of the road without straining the drive. In the case of trucks, the transmission is of the same general design, but a continuous-tread mechanism is used instead of a drum.

The driver controls the pressure of this drum or tread against the snow by means of a hand wheel near the steering column. On hard-packed roads, the weight of the unit is sufficient to drive the car, but in soft snow pressure is put on the drum until it is below the level of the sled-runners. Thus the weight of the car compresses the soft snow, and good tractive effort is secured. In spaces free from snow, the front runners can be removed, and the car driven on the front wheels and the rear drum, with the rear runners lifted from the ground. The passenger sledge, it is claimed, can make speed up to 30 miles an hour, while the truck can travel at 15 miles.



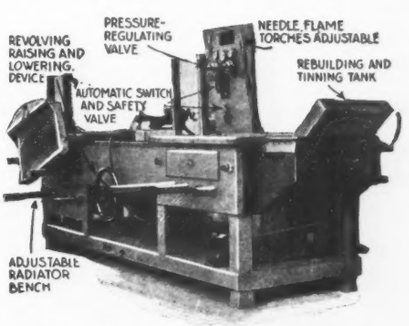
For the truck, the driving apparatus is a continuous-tread mechanism

Special Bench Simplifies Radiator Repairs

BETTER work as well as increased speed is possible by the use of a bench specially designed for radiator repairs. The radiator can be carefully tested for leaks, without guesswork, and the leak can be easily soldered when located.

The workman's hands are always free. The bench will turn, raise, and lower the radiator, and hold it in any position wanted.

The first step in repairs is to place the radiator in the holding device and connect it with air pressure supplied by the compressed-air outfit on the lower shelf to remove any temporary stoppage. It is then lowered by the hand wheel into the water-tank in the center. When a leak appears, the point is marked, the radiator raised by the hand wheel, and the hole soldered by an adjustable needle torch on the board.



The bench will move the radiator to any position and hold it there

Old tops and bottoms are removed by dipping the radiator in the tank at the right, which is full of melted solder. This gives an even heat, and will not injure the brass, which is always a possibility when a blow-torch is used. The tubes are then cleaned and afterward tinned by dipping them in the tinning-tank.

Steam Motor May Prevent Disastrous Airship Fires

British Officer Designs New Aircraft Engine which Will Reduce Danger and Develop Greater Power with Less Fuel Waste

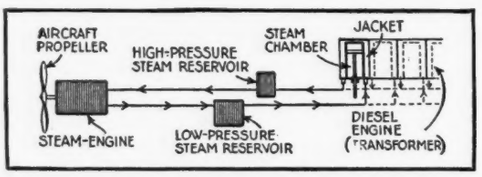
By P. J. Risdon
English Correspondent of Popular Science Monthly

WILL the use of steam power in place of gasoline reduce the dreaded danger of fire in aircraft? Will the steam-engine, too, develop greater power with less waste of fuel, permitting the operation of the long-prophesied passenger airlines?

Captain W. P. Durtnall, formerly of the British Royal Air Force, has designed a steam-motor for aircraft which, he hopes, may prevent a repetition of the frightful ZR-2 disaster. He claims that his motor may even be placed inside the gas-bag of a rigid airship, or that it may be carried within the wings and fuselage of a huge plane without the slightest danger that the craft will catch fire.

The reliability of the steam-engine is combined with the lightness of the internal-combustion motor in the design of Captain Durtnall's new engine. The power is furnished by an oil-burning Diesel-type motor. The propellers are driven by steam. Heat from the internal-combustion cylinders, usually wasted, is utilized to generate low-pressure steam in the cylinder jackets. The cylinders are arranged so that when the oil is fired on one side of the piston, steam is compressed on the other side, in the lower portion of the cylinder.

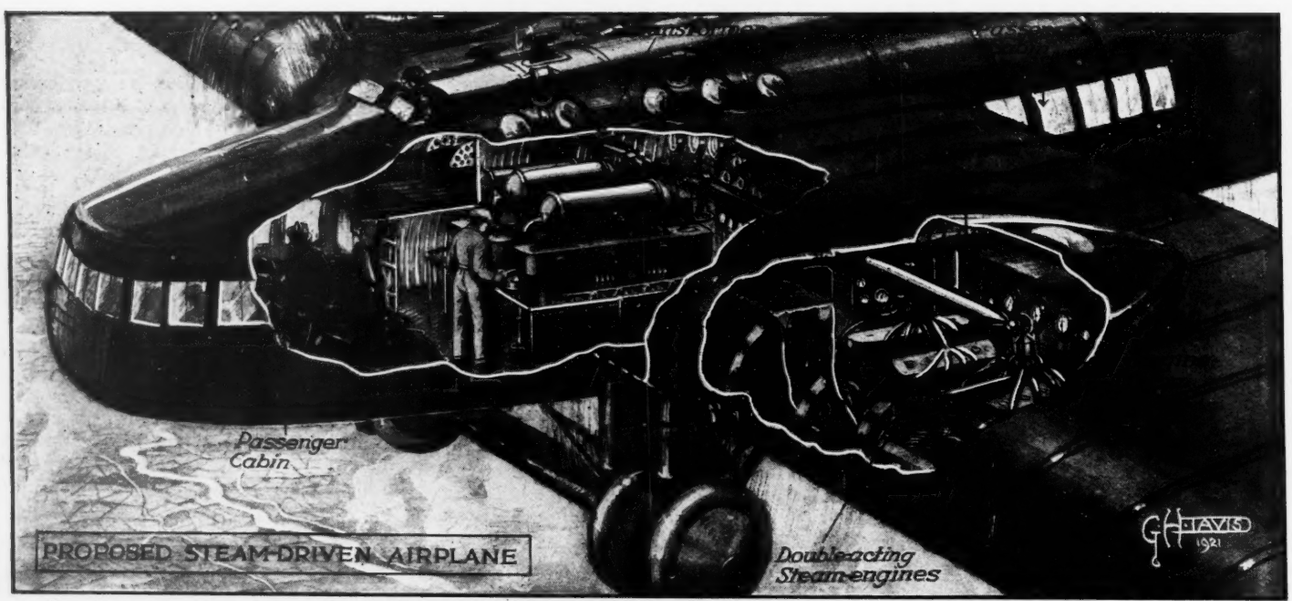
On the upward stroke of the oil engine, low-pressure steam enters the cylinder through the inlet valve to be compressed. Just before the explosion, the low-pressure steam inlet closes, and after the explosion the highly compressed, superheated steam passes out through a second port into the high-pressure steam reservoir. Thence it is led to steam-engines, drives the propellers, and exhausts into a low-pressure cylinder, from which it returns to the Diesel engine to be compressed again. All the piping, reservoirs, and engines are lagged to prevent the loss of heat. The steam is used over and over in a closed steam circuit.



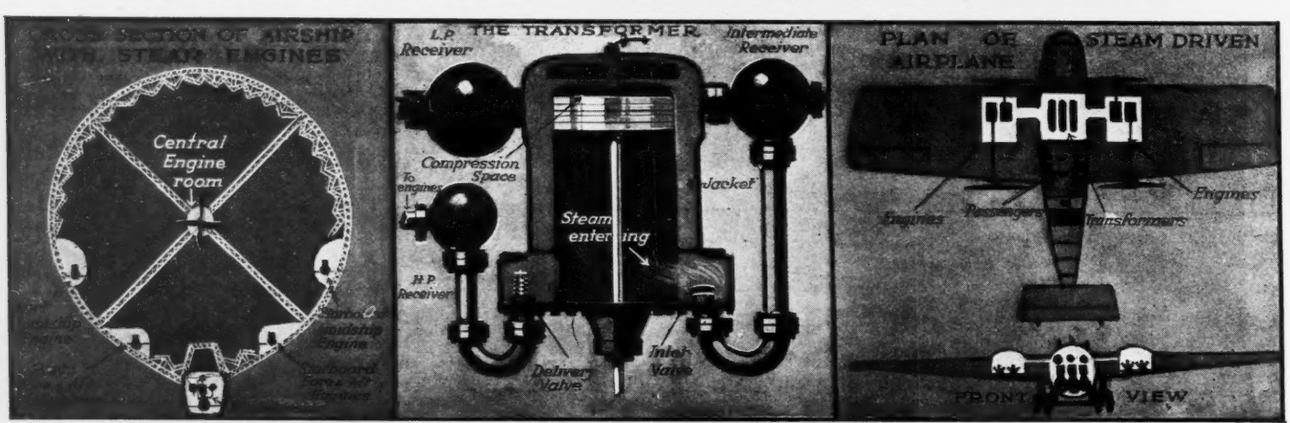
In the Durtnall system steam is generated in the outer jackets of the Diesel engines and conveyed to the steam-engines that drive the propellers

No gasoline is carried. The fuel consists of heavy oil into which one might safely throw a lighted cigar. As the propellers are driven by steam, there is no reason why the engines cannot be placed in what is their logical position—on the body of the airship itself. In the past, gondola engine cars have been slung to the bottom of the hull, like a towboat, simply because a gas-engine near the hydrogen-filled bags would have made an explosion almost inevitable.

The use of steam should assure increased reliability. By stepping up the speed of the slow-running Diesels through variable speed gears, the propellers of the Durtnall plane could be run at any speed desired without likelihood of engine failure.



In giant passenger planes, the double acting steam-engines would be placed in the cantilever-type wings. The transforming engine in the fuselage would be separated from the forward passenger cabin by a collision bulkhead



Left—A cross section of a rigid airship, with the engine-rooms inside the hull and transforming engines in the keel space. Center—Plan of the transformer for converting low-pressure steam into high-pressure steam. Right—Arrangement of the engines

Do You Use a Chemist in Your Business?

Whether Your Enterprise Is Large or Small, You Can Keep Your Products Healthy by Calling In the Expert

By James H. Collins

ONE of the plumpest coffee contracts ever landed was for the coffee used at the Pan-American Exposition. A St. Louis coffee man got it—but the order nearly slipped through his fingers. He blended a whole carload for a sample and shipped it to Buffalo. When it left St. Louis it seemed about as fine a blend as he had ever made. But a telegram came back saying, "Coffee shipped us will not do—it is rotten." After studying the problem, the St. Louis coffee man, mystified, finally had a sample of Lake Erie water analyzed by a chemist, who reported a much higher percentage of alkali than is found in the Mississippi River water used in his own city. With a big jug of Lake Erie water for testing, he blended a new sample, adapted to the water Buffalo people used, which was delicious, and landed the exposition coffee concession.

Dozens of cases of beverage were returned because they developed a sediment. After the manufacturer had sought in vain for a remedy, a chemist immediately located the trouble in overworked water-filters

Tests Forestall Trouble

Some business men call in the chemist when their products get sick, like this coffee man. But more and more business men are learning to retain a chemist to keep their products well. His Buffalo experience brought the man from St. Louis more than an order—by having a chemical analysis made of the water in every section where he sought coffee business, and blending to meet local conditions, he has built up about as large a coffee trade as you will find in the Middle West.

The materials of industry are almost universally unstable—cellulose, starch, fat, fiber, ore, and the like differ from day to day and from season to season. Nature has not standardized them—that job is left to man. It is a chemical job. Daily tests and adjustments will forestall trouble, which is more profitable than finding out what is the matter after things have gone wrong.

The small business needs the chemist just as much as the big corporation—very often more. But turnover seldom warrants the employment of a chemist as part of the organization. The small business man thinks he cannot afford consulting chemists, chemical engineers, and research men, although he knows they might help him improve his products and guard against losses.

Small men are constantly starting in lines of industry that, with success, develop national distribution and large-scale production. But they, too, lack the means to employ chemists steadily and to set up a department for chemical control and research. Very often their enterprises are wrecked at the start because they lack technical knowledge, and do not know how to buy it of the consulting experts.

Nevertheless, small business men are learning to call in the consulting chemist when things go wrong, and this leads them to retain him for part-time service by the year, and consulting chemists are evolving ways of giving such service, so that now it is within the means of virtually every business man.

Many Emergency Cases

Many of the consulting chemist's cases are of the emergency kind. Mr. Arthur R. Maas, a consulting chemist of Los Angeles, gives some illustrative cases from his own practice. One of Mr. Maas's recent clients was a candy manufacturer who had been making chocolate creams several years—excellent confectionery that found an expanding market. Suddenly, for no apparent reason, his chocolates acquired the habit of exploding. A chemical and microscopic examination of the burst candies showed that the trouble was due to fermentation—bacterial action. Following that clue through the various ingredients and processes, the chemical criminal was finally located in egg albumen, which had become contaminated. We import considerable egg albumen from China, and lately there has been much complaint about fluctuating quality. When this albumen was sterilized, the candy-maker's trouble disappeared.

Another bacteria mystery was that of a small bottler of soda pop and ginger ale. Dozens of cases of these beverages were returned to him because they developed a cloudy sediment. He tried various ways of eliminating the trouble, but without success. A chemist detective was put on the trail, and located the difficulty in overworked filters through which water used in making the beverages was passed.

Materials Must Make Good

"We hear much these days of inefficient labor," says Mr. Maas, "but little is said of an equally important factor in present high prices—inefficient material. The markets are full of materials that give but half service. A great part of the national wealth is either wasted or very poorly used. It is the business of the chemist to determine the value of materials and to fit them to their proper use."

And that is a job, not for the chemical Sherlock Holmes when trouble arises, but of every-day supervision of materials. Just as human workers are kept track of through time-clocks and foremen, and machinery is supervised by engineers and production sheets, so materials are managed by the chemist. He hires them, figuratively speaking, tests their ability, assigns them to jobs where they will make the best showing, and fires them if they are lazy or incompetent.

About one small individual enterprise in five starts with "The recipe of an old Virginia family," or "A formula followed without variation for

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY

more than a hundred years." People often have an almost superstitious faith in formulas, especially where successful enterprises have been built up on them. They are regarded as sacred, and not on any account must they be changed.

But from the chemist's standpoint formulas can often be improved or changed to meet changing conditions. Maybe the ingredients used in a given product rise in price so that the manufacturer finds his profit disappearing.

In one case a manufacturer was making a dressing for automobile tops. Shellac, linseed oil, and other ingredients in his formula began to go up—up—up! His profit disappeared, and finally it was impossible to make the product at a price low enough for popular sale. Chemical investigation led to the development of a new formula quite as good, with marked reductions in the cost of other materials, and the business was put back on a paying basis.

A story is told of a small manufacturer using a certain brand of adhesive in his product, part of the formula. It cost him several dollars a pound. A Boston consulting chemist analyzed the stuff, and told him that it was a staple gum which he might buy for one quarter the price in the open market.

Sound sense in this matter of formulas was shown by a young man about to embark in business with small capital. A formula for a deodorizing powder had been offered him. That seemed a promising business to get into, and the formula looked all right, but distrusting the seller, he submitted the formula to a chemist before purchasing. It was found correct, but later when he came to set up his plant, he discovered that the machinery specified for the process would cost far more than he had figured. Again the chemist was consulted, and suggested a smaller, less expensive plant, capable of turning out all the deodorant he would be likely to sell for several years, during the time he was building up connections and distribution.

Without such counsel as this, the young man would probably have gone bankrupt, as do many small business pioneers in similar circumstances, who call in the chemist a few days ahead of the sheriff.

How the Chemist Can Help a Small Business

TOO many business men think that chemists are a luxury that can be enjoyed only by the large manufacturing corporations. They do not know that chemists can be hired like doctors or lawyers, that their fees are very reasonable, and their services often invaluable.

Read this article by Mr. Collins and see if some of its truths do not apply to your own business, however small it may be.

If the consulting chemist cannot improve your product, he can, at least, prevent losses due to your lack of manufacturing knowledge.

The markets are full of materials that give half service. A chemist will pay for himself, even if he determines only the value of materials and fits them to their use.

According to one successful chemical engineer, Mr. Jasper Whiting, the development of a manufacturing process should be divided into five separate stages. First, is what he calls the "beaker" or laboratory stage, which begins with a search of patents and technical literature to see if the process is new, and if other processes can contribute toward it, along with analysis and study of the ingredients to be used, determining whether they are reasonable in price, abundant in supply, if other ingredients might be substituted, and whether the proposed product is commercially feasible. This work may be carried out with a few pounds of ingredients. Second, a small model of the process is then set up—a miniature plant large enough to turn out stuff using the regular ingredients, and sketch out the best sequence in manufacturing. Third, a "lifesize unit" is built, with machinery arranged just about as it will be in a real factory. But even here the consulting chemist works with his own laboratory machinery.

Business men are gradually learning to call in the consulting chemist when things go wrong

Up to this third stage, the outlay in capital is moderate, and mistakes are not disastrous. The chief investment is in the form of time, energy, and patience. Mr. Whiting declares that application should not be made for a patent covering the process until this third stage has been gone through.

Now, money is needed for the fourth stage, a semi-commercial plant that duplicates the lifesize unit, and has capacity to turn stuff out in market quantity.

Chemical control begins as real batches of actual commercial ingredients are worked up—impurities and variations are detected, more mistakes eliminated, and the groundwork of selling and distribution can be laid out.

Finally, out of it all comes the commercial plant itself, and if the previous work has been thorough, this should operate profitably, because most of the leaks, errors, and unforeseen factors have been spotted and kicked out.

Fifty years ago there were probably not more than half a dozen chemists employed by industrial concerns in the United States. Andrew Carnegie was the first steel manufacturer to employ a chemist, who came from Germany. Carnegie was mercilessly ridiculed by his competitors as a sort of industrial highbrow. But improvements in his product soon sent his business rivals scurrying for chemists.

To-day, our major industries employ hundreds of chemists, and every large city has its consulting practitioners who may be consulted by the small man for moderate fees. The chemical engineer, however, is not as plentiful as he should be and probably will not become more so until his existence becomes more known, and the tremendous business importance of his ministrations receives its rightful recognition; and until both chemists and manufacturers distinguish between the chemical engineer and the analytical chemist. The analytical chemist is a chap thoroughly educated in our best colleges and institutions, but taught chemistry without much regard for its application to industry. You give him samples of ingredients, and he will be able to tell you

what is in them. But when it comes to making marketable goods out of those same ingredients, improving old processes and devising new ones, he lacks constructive engineering training. That was not included in his education. He will analyze a varnish for you, and tell you much about its composition, but he cannot tell you how to make it on a manufacturing scale.

"How many different kinds of businesses in this community can use chemical service?" was asked of a consulting chemist in a certain city.

Variety of Clients

"The shortest and quickest list would be one showing lines of business that don't—perhaps can't use it," was his reply. For the other kind of list, however, I can mention business lines in which we have clients. Here are some of them:

Advertising agency	Hotel
Automobile dealer	Ice company
Bakery	Ice-cream manufacturer
Belt manufacturer	Ironworks
Beverage manufacturer	Jeweler
Brickyard	Laundry
Cannery	Lumber dealer
Candy manufacturer	Mineral spring
Coffee and tea concern	Mining company
Creameries	Nut-growers' exchange
Coal company	Oil-well
Cold-storage warehouse	Packing-house
Dairy company	Paint factory
Department-store	Retail butchers' association
Evaporator	Saltworks
Fertilizer company	Seed house
Fish cannery	Sugar company
Flour-mill	Vinegar works
Fruit-growers' exchange	Waterworks
Gasworks	Wholesale grocery
Grain dealer	

"What can a chemist do for a fruit-growers' association? We solved a trade-mark difficulty—glue used to paste a small label on each orange refused to stick, though many varieties were tried, when we were called in and devised a stick-fast formula.

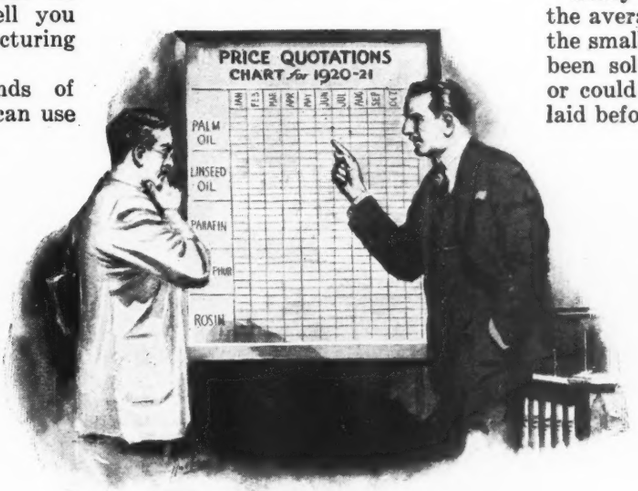
New Uses for Nutshell

"A nut-growers' association? Enormous piles of walnut shells accumulating after the installation of cracking machines suggested that the material might be good for something. Here was a real chemical-engineering opportunity—the chance to evolve a new industry. It was found that the shells could be turned into charcoal, that the charcoal was a desirable element in poultry feeds, and that the gases from charcoal making would yield creosote, acetic acid, acetone, and wood alcohol.

"An oil-well? There was a profitable one near by. Its owner noticed that a certain amount of natural gas was produced, but was so busy pumping and selling oil that he didn't think it worth saving. The flow was measured and tested chemically, and we found that about three hundred dollars' worth of gas and gasoline had been going to waste daily. A compressor plant was installed to save this evaporating income."

The application of chemistry to meat packing, particularly in converting bone and trimming into glue, is also a familiar one.

The consulting chemist nowadays is as sympathetic, broad, and resourceful as a family physician. He welcomes the small man as a client, sits down and talks over his problems from the engineering, plant, and human standpoint, perhaps leaving chemistry last. In the growth of the small man lies the growth of his own practice, not to say the variety and interest of his work. In the growth of the small man, moreover, if you want to look at it from the standpoint of human service and natural progress, lies better utilization of our resources, better opportunities for the little fellow to hold his own against big interests, and the chance to expand in world trade. For this reason the matter of fees is put upon as reasonable a basis as possible.



It is the business of the chemist to determine the value of materials and fit them to their proper use

Some business men have an instinctive dread of professional fees, losing their sense of proportion when they think about them.

"Fifty dollars!" exclaimed a manufacturer who had asked a consulting chemist what a rather involved little investigation would cost. "Why, I never paid more than five dollars to a chemist in my life!" Yet a fifty-dollar printing bill or a ten-thousand-dollar advertising campaign would have seemed reasonable enough to this man, because it was an ordinary item of business expense.

It does not cost anything to find out what a consulting chemist will charge for a given job. He figures it on the time, work, material, and apparatus required. A regular service of analyses, tests, and supervision costs less by the month or year than the single emergency case. It is plain business no less than professional ethics that stimulates him to deliver results, which causes the client to forget fees and retainers.

Business generates problems. Perhaps eight times in ten a technical problem will be chemical—and very often a problem of selling, supervision, finance, or policy is obscurely chemical when run down to fundamentals.

Puzzling Problems Solved

Many of the problems that puzzle the average business man, particularly the small man and the beginner, have been solved already by the chemist, or could be cleared up immediately if laid before him. The real problem is to get the business man and the chemist together. During the past few years chemists have acquired a better understanding of business and business men have acquired a better understanding of chemists. Business is becoming more scientific; chemistry is becoming more human. As they come closer together, each grows through teamwork. The initiative in getting acquainted, however, lies largely with the business man—he is the fellow who has the problems to be solved, whether they be of an emergency or of a routine character.

Revolving Phone Directory Speeds Up Exchange

GREATER speed at the office telephone exchange may be secured by a revolving telephone directory which is attached in the rear of the mouthpiece and consists of a series of index cards set in slots in a wooden hub. The cards can easily be read by the telephone operator through the yellow celluloid cover of the invention.

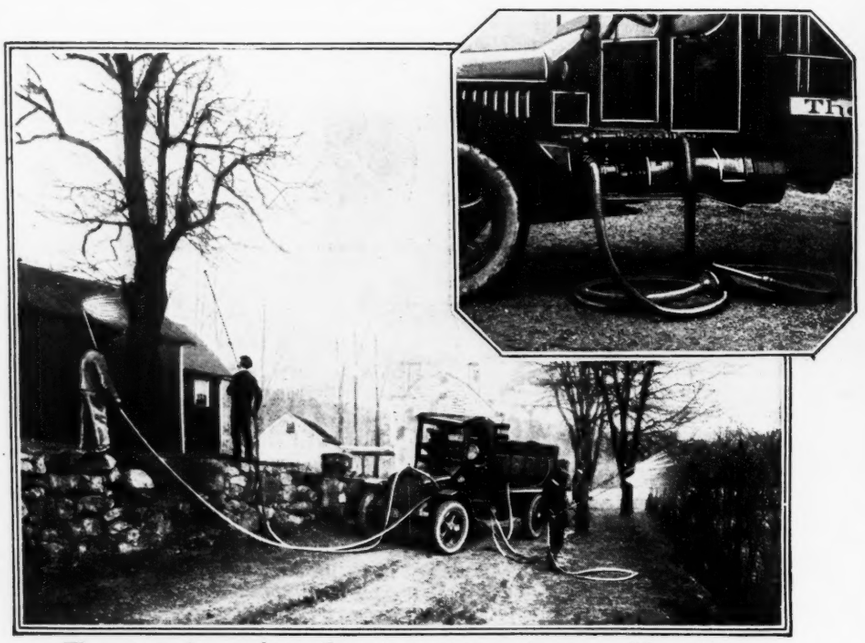
Nearly a hundred names can be handled on the wheel, in spite of its small size. The cards are placed in alphabetical groups in the slots, and the operator, instead of having to use a full-sized telephone directory, always has the most frequently called names and numbers under her thumb, where they can be found in a second. Cards can be taken out of the rack or new names can be added.

All-Purpose Motor-Truck Does the Farmer's Chores

In Latest Model, the Engine Supplies Power to Saw the Wood, Pitch the Hay, Spray the Orchard, and Eliminate Drudgery All Round

"WHAT have you found to be the principal advantages of a truck for farm work?" was the question recently put to the farmers of the Atlantic States by the United States Department of Agriculture.

Answers to this were divided as follows: Saving time, 92 per cent; saving horses, three per cent; better markets, two per cent; convenience, two per cent; reduction of expense, one per cent.



The upper picture shows the rotary-pump equipment, with suction and discharge pipes and four spray-line connections. Below, the truck pump in action is spraying trees and vines through the four lines. The suction line leads from a tank on the truck body

HAULING produce to market is only one item in the usefulness of the latest truck, designed especially to meet the farmer's needs. When the truck is not busy on the road, it will spray the orchard, pitch hay into the barn, collect the winter's wood and saw it into cordwood lengths—in a word, the truck engine furnishes power for the many chores that in the past have made the farmer's life laborious.

By the exercise of ingenuity, of course, many a farmer has made a truck help him in his work, but in the new model the ingenuity has been supplied by the manufacturer after an extensive study of the farmer's requirements. The result is seen in special appliances that will perform the maximum number of chores with the minimum amount of effort.

The truck itself is of a type that has proved reliable and efficient in over 20 years of commercial test. On the chassis is set a body that can be adjusted either to a simple wagon with a flat steel platform, such as is needed in hauling fence-posts of lumber, a common box body adapted to the majority of tasks, a high covered wagon like a prairie schooner needed for carrying cattle, or a high-sided body suitable for hauling bundles of corn, hay, or other bulky field products.

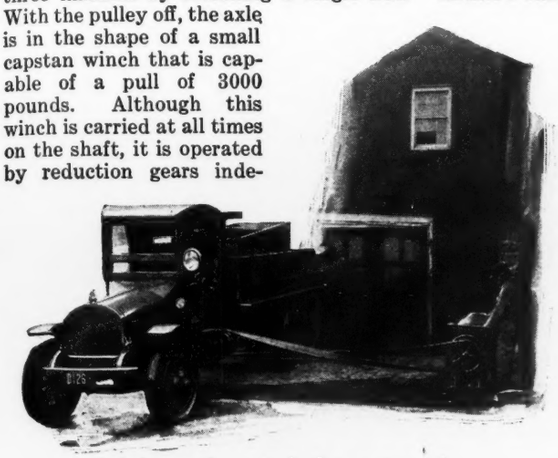
The feature that makes this preeminently the farmer's truck, however, is a group of attachments immediately behind the engine on the left-hand side, all operated by the engine through a system of gears. Here is a pulley 13 inches in diameter and 6½ inches wide that drives at belt speeds standard for farm machinery. The pulley itself consists of a hollow casing, open at one end. The engine provides ample power to grind feed, saw wood, or

Speed Records of Many Entries in Light-Car Derby

With amazing speed that thrilled the greatest crowd ever in attendance at the Brooklands speedway in England, 72 of the world's smallest racing-cars recently justified England's growing interest in the small, economical, yet powerful cycle-car. The photograph above shows the little speedsters lined up for the starting-gun of the 200-mile contest

operate the silage-cutter or the threshing machine.

The pulley can be removed in less than three minutes by loosening a single nut. With the pulley off, the axle is in the shape of a small capstan winch that is capable of a pull of 3000 pounds. Although this winch is carried at all times on the shaft, it is operated by reduction gears independent of those driving the pulley. They operate only when the winch is being used. To provide a better lead for the ropes in hauling hay, a roller guide is mounted on the truck body immediately behind the driver's seat.



A belt can be attached to a special flywheel for sawing or grinding

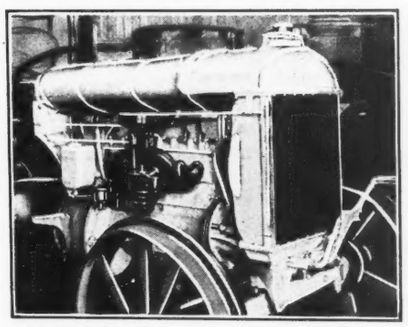
Next to a source of power, the modern farmer's chief need is for a pump, and the truck helps him here with a centrifugal pump with a capacity of 35 gallons a minute, a suction of 12 feet, and a working pressure of 75 pounds to the square inch. It is fitted with a suction and a discharge hose, strainer, and nozzle, so that it may be used for putting out a fire, washing the car, or watering stock.

From the top of the pump leads the spraying manifold. This has fittings for a 1½-inch suction and discharge connection, and four one-inch spray-line connections. In using the truck as a spraying machine, the tank holding the solution is placed on the body, and the suction pipe placed in it. The four nozzles provide work for as many men as can usually be employed in one location. This same apparatus can be employed to spray liquid fertilizer.

Slip-On Extension Crank Aids in Starting

SIX additional inches of leverage in a new extension crank make it easy for a small man to crank the stiffest motor-truck, for the extension increases the power applied to the flywheel by fully 50 per cent. A truck or a tractor engine can be spun as a man spins the engine of a light car.

The extension handle slips on and off readily. The handle of the crank already attached to the car fits into a hole in the center of the extension arm, which is locked to the base of crank-arm by a curved lip. This curved lip insures that the arm will fall off harmlessly if by any chance the engine back-fires.



The extension arm can be slipped over the handle of the crank

Ask About Your Motor Troubles

Speedometer as Gasoline Gage

Q.—Can you give me a suggestion as to how to keep track of my gasoline consumption without fitting a gage to the tank?—H. A. L., Tampa, Fla.

A.—When the car lacks a gasoline gage, the trip odometer may be used as a convenient substitute. When the gasoline tank is filled, the trip figures are set to zero. If the average mileage a gallon is known, it is not necessary to fill the tank until the approximate distance represented by the number of gallons in the tank has been traversed. For example, a certain Ford owner obtains eighteen miles a gallon. He buys five gallons at a time, or ninety miles. At the time of purchase he turns the trip to zero. When the car has been run about eighty miles, he knows that his supply is running low, and therefore buys more gasoline.

Trouble with the Ammeter

Q.—My ammeter shows "Discharge" when the engine is running, and "Charge" with the lights on. What is the trouble?—J. I. L., Bowmanville, Canada.

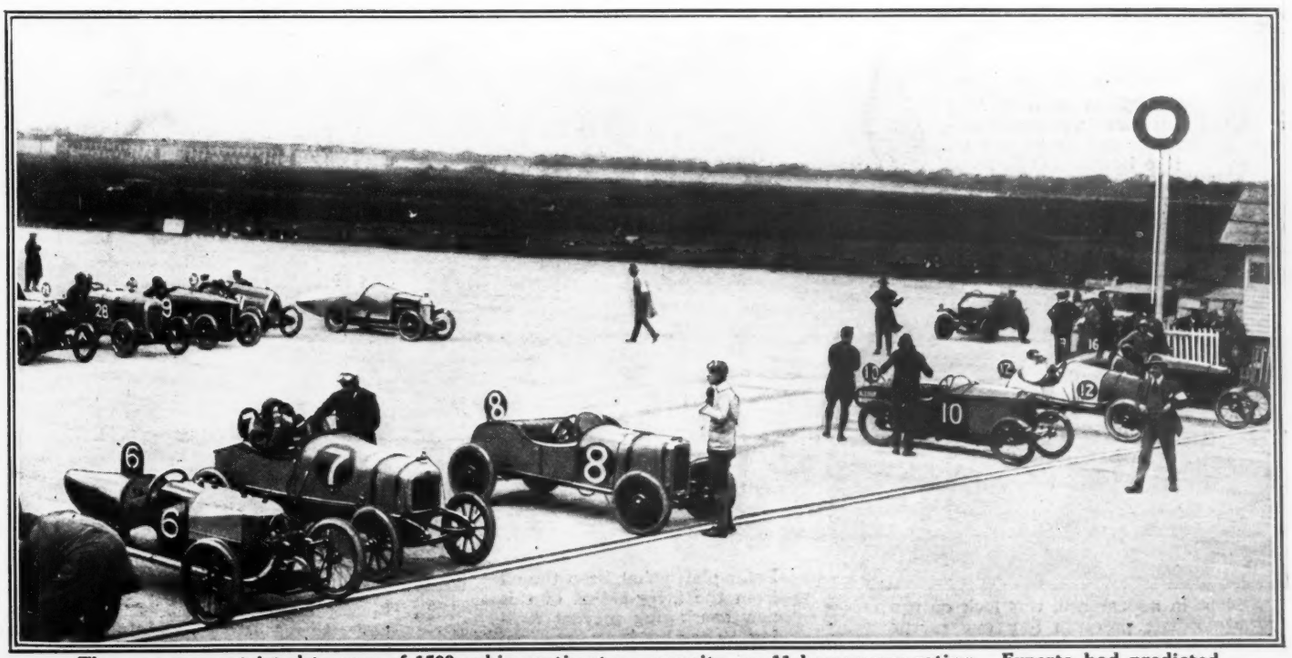
A.—Probably the reason your ammeter shows discharge when the engine is running and charge when it is not is found in the fact that the ammeter is connected up backward. If you will reverse the connections on the ammeter, it will undoubtedly register properly.

Fuller's Earth Cures Clutch

Q.—My clutch has a tendency to slip. It is a cone type, faced with leather.—C. T. S., Joliet, Ill.

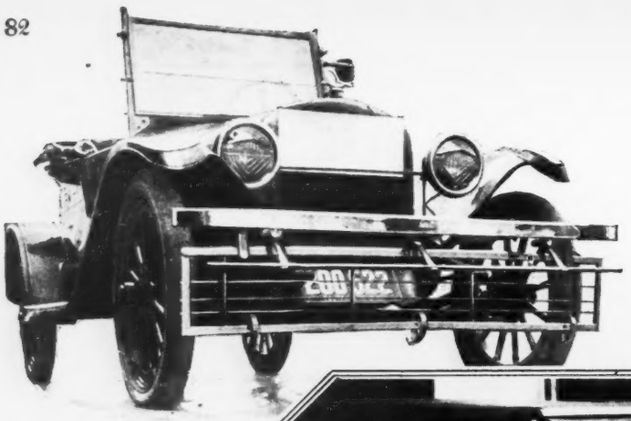
A.—Fuller's earth spread as best you can on the surface of the leather will cure the slipping. Remove the floor-boards, hold the clutch out, and dust the leather surface with the aid of a business card as a shovel or scoop. Fuller's earth may be bought at any drug-store.

Justify England's Growing Interest in Cycle-Auto

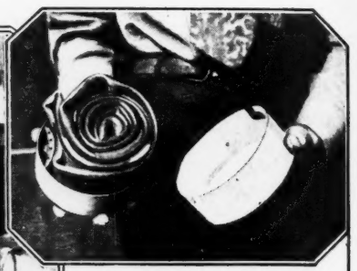


The race was restricted to cars of 1500 cubic centimeters capacity, or 11-horsepower rating. Experts had predicted it would be won at between 60 and 70 miles an hour; but the winner, surprising even the most hopeful, averaged 88.82 miles an hour for 200 miles! The first three places were won by three diminutive Talbot-Darracq machines

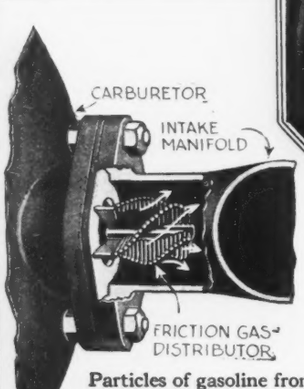
Just What You Want for Your Car—Perhaps It Is Here



If the automobile strikes a pedestrian, the shock drops this fender to the ground, preventing the person who is struck from falling under the wheels. The fender may be dropped by the driver of the car



This box of drawn steel protects an inner tube. After the box is locked, a few pounds of air is forced into the tube through the projecting valve-stem



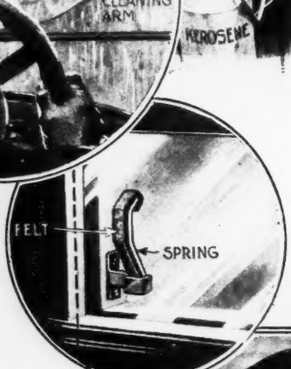
Particles of gasoline from the carburetor strike the distributor's corrugated surface, break up, and are vaporized thoroughly, increasing the power-return a gallon

Overalls, or coverings, to protect the highly finished enamel of the automobile body while undergoing repairs, represent the latest form of "service" in the up-to-date garage. The covers are equipped with springs that snap over hoods, fenders, and doors

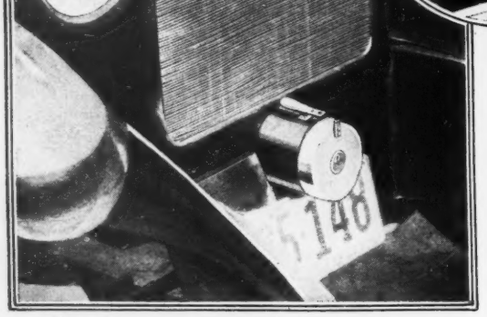
A spraying nozzle attached to the air line facilitates cleaning the engine with kerosene

A vacuum motor swings this rubber squeegee across the wind-shield, automatically keeping it clear in wet or foggy weather

An oilcan with a long spout and a pump attachment will force the oil into locations difficult to reach, such as the cone of the clutch

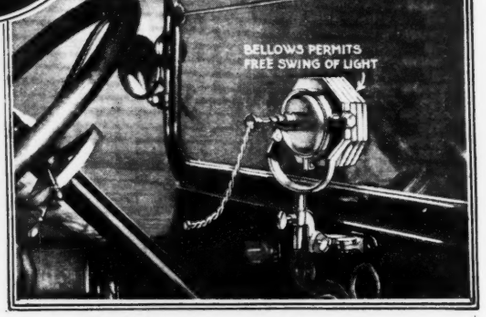


Flat springs, covered with felt keep the windows from rattling

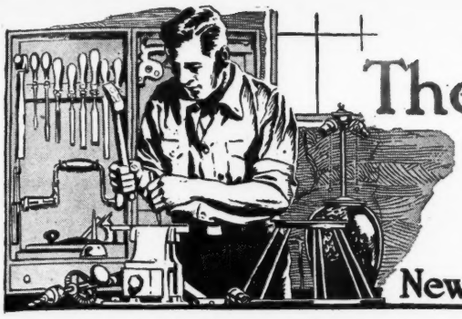


Neat in appearance, this lock on the crankshaft prevents any one except the owner from starting the car. Breaking the lock automatically disables the engine

Baffle-plates that keep the oil from the firing-points of this new spark-plug prevent fouling. The plug is screwed into the cylinder in the usual way. A priming-cup is provided for cold weather



Spotlights placed inside the car are easier to reach, and in addition eliminate side glare or light on the windshield that might interfere with vision of the road in night driving



The Home Workshop

New and Useful Things for the Practical Man to Make

New Blueprint Service to Aid Home Workers

TO help you obtain the best possible results in your home workshop, POPULAR SCIENCE MONTHLY offers you the assistance and cooperation of a unique Home Workshop Service Department.

The primary purpose of this department will be to furnish you with full working blueprints and bills of material for at least one of the most interesting, original, and useful objects described each month in the Home Workshop. A nominal charge of twenty-five cents will be made to cover the cost of blueprinting, handling, and mailing. The cost of designing and drafting will be borne by the magazine.

The value of these blueprints is obvious. They will provide you with every dimension, every detail, every bit of information you need to make the article, whatever it may be. They will save you the trouble of making a working drawing yourself; they will eliminate guesswork; they will show you the best, quickest, and most workmanlike methods of construction.

Insuring Your Success

By having definite sizes and details, you will be able to devote more of your attention to the fine points of construction and to the small variations of design and finish that will make your work individual. You will be free to give your work those qualities that distinguish all good hand work from the product of factories.

You will be able to work with confidence that the finished article will be good in design. The designers will have taken care of that for you; as they would say, the design of the article will adequately express its function or use and its "space relations" will be nicely adjusted. In other words, the main proportions of the object will be correct and pleasing to the eye. And that is the secret of making work appear well.

Several methods of construction will be indicated, whenever possible—a simple, easy way for the beginner or the man who hasn't very much time for bench work, and a more craftsmanlike way for the experienced worker who likes fine details.

Nearly as useful to you as the working drawing itself will be the accompanying bill of materials. Every item you need will be clearly listed and the material and size and number of each item required will be indicated. That will save you time, energy, and money. You will be able quickly to get just the materials you need without any waste.

Because many more Home Workshop readers have tools for wood work than for metal work, the first blueprints will be concerned with wood-working projects. Working drawings of metal projects will be provided later if it appears that there will be sufficient general interest in them. For that reason the Home Workshop editor would be glad to have readers write freely to him about what they think of this new idea and about what articles in either wood or metal they are most interested. State just what working drawings you could use yourself. Ask any questions that occur to you, either about the blueprints or about any other articles in the Home Workshop. It is your department, edited for your benefit, and your ideas and comments are always welcomed.

The detailed drawings of this sewing-table are obtainable in blueprint form from the new Home Workshop Service Department

Details of a Sewing-Table

THE first blueprint, now ready for distribution, contains the details of a sewing- or work-table like the illustration. This is a table to delight any woman's heart, and one that will give the home-worker much pleasure to make.

The beauty of the design lies in its simplicity. The table is of oak, plain or quartered, although it may be made of whitewood and enameled or stained to represent mahogany. The enamel finish is recommended to the beginner, because any defects in the construction will not be so noticeable.

The top is 1 ft. 8 in., by 1 ft. 4 in. with two drop leaves, each 1 ft. 4 in. by 9 in. When raised, these leaves are supported by hinged wooden brackets. There are two small drawers with a larger compartment beneath them. This compartment has a drop front that when open will conveniently support the workbasket or sewing materials. The legs are solid and are chamfered off to an octagonal shape at the bottom. The frame is dowelled, and two methods of making the drawers—one simple and the other more difficult—are given.

The finishing should be carefully done. The oak may be stained golden, weathered, Flemish, or any desired color, filled with a paste filler, shellacked, and varnished, provided you have a good, dustless room in which to work and that you can put on the shellac smoothly. A finish that is not so enduring but that may be easily renovated and kept in good condition is made by staining, filling, and waxing the table.

If made of whitewood, the table can be stained mahogany and finished as above, or it may be given several coats of enamel—white, cream, or any delicate color. White paint may be used for the first coat, if desired. There are various prepared varnish stains and other finishes on the market, but care should be taken to follow exactly the manufacturer's directions.

The blueprint of the sewing-table is 51 in. by 22 in. It contains a complete assembly drawing and full-sized details of all the essential parts, as well as a completely itemized bill of materials.

Smoking-Cabinet for Next Month

Next month's project will be a smoking-stand of exceptionally interesting and original design. Three or four methods of making it will be suggested, so that it may be made by the man who works only with a hammer, saw, and plane, or by the craftsman who delights to linger over a problem and enrich it with carving and inlaying.

These plans will go far toward assuring your success in the home workshop. If you wish the blueprint of the sewing-table, send your name and address with twenty-five cents to the Home Workshop Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York, asking for Blueprint No. 1, or use the coupon you will find on page 92.

How to Hook Up an Audion Detector and Amplifier

By Arnold Holmes

AFTER the beginner is thoroughly interested in radio communication, he soon becomes ambitious to hear some of the distant stations he has not heard before, as well as to hear the near stations a little louder. This can be accomplished with the aid of an audion detector and amplifier. The audion set is necessarily more complicated and requires more auxiliary equipment; it is, therefore, much more costly.

What are the additional pieces of equipment required for the audion set? The audion, as you know, requires a filament battery, a plate battery, filament rheostats, the grid and plate condensers, coupling transformers, and so forth. All of these auxiliaries are not only expensive in the first place, but storage batteries must also be charged occasionally, plate batteries must be renewed, and the tubes sometimes burn out, so it is evident that the audion receiver costs money to operate. The additional first cost and the extra operating expenses are, nevertheless, more than repaid by the excellent results obtained from a receiver of this sort. The experimenter gets considerable satisfaction in being able to hear the long-distance messages with the phones on the table.

What kind of a circuit should be used? It is general engineering experience that a detector and a properly constructed two-stage amplifier is about the practical limit of amplification when using the ordinary type of antenna. More amplification will give louder signals, but the static and interference will also be louder. In a good many cases a detector and one-stage amplifier are ample.

Jacks Localize Trouble

Figure 1 is a circuit diagram showing the circuit of a detector and two-stage amplifier. The binding-posts 1-1, 2-2, and 3-3, and the jacks J1, J2, and J3, provide means for getting into the circuit in the output of the detector, either a one or two stage amplifier. This, together with the variation of the filament rheostats, provides a convenient means of amplification control.

In the case of trouble in the detector or amplifiers, the jacks can be used to localize the trouble. For example, suppose the first amplifier were in trouble; no signal would be heard on jacks 3 and 2, but signals would be heard on jack 1. This immediately gives the experimenter a clue as to where the trouble is.

It is never advisable to operate the audion above its rated filament current because the life of the tube decreases very rapidly with increased filament current. I have been told that in some tubes a 3 per cent increase in filament current causes a reduction of 50 per cent in length of life, while a 3 per cent reduction in filament current causes the tube to last twice the ordinary life at the rated filament current. Since there are so many filament rheostats, grid leaks, and grid-leak resistances, shunting condensers, coupling transformers, etc., on the market at the present time, it would be a waste of time to describe in detail their construction.

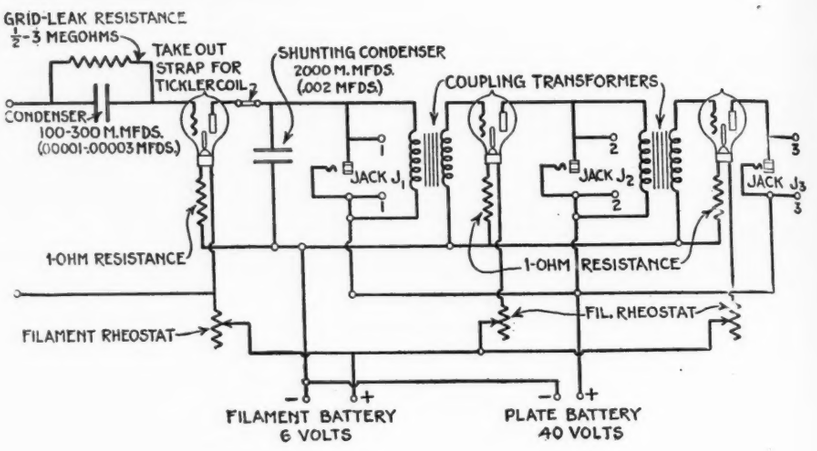


Fig. 1. Circuit diagram showing all the details of the hook-up of a detector and two-stage amplifier

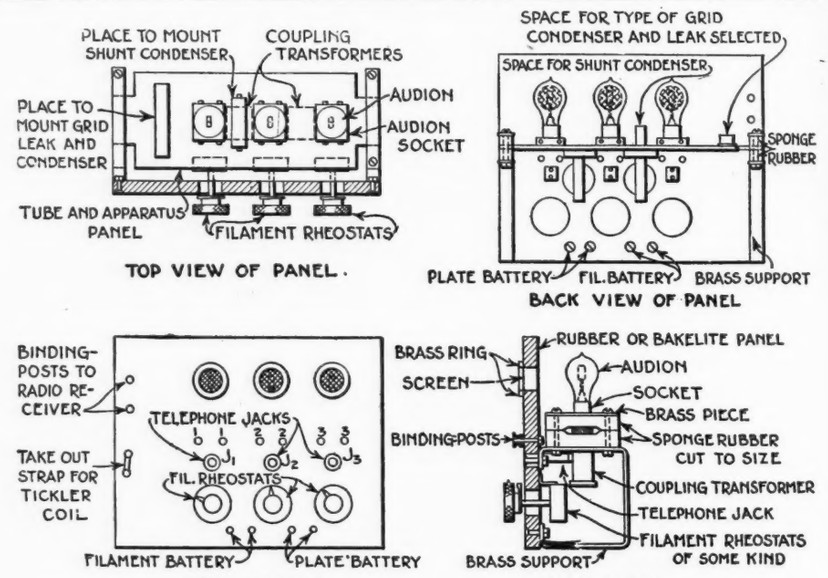


Fig. 2. Details of the detector-amplifier showing how the apparatus should be mounted on a panel

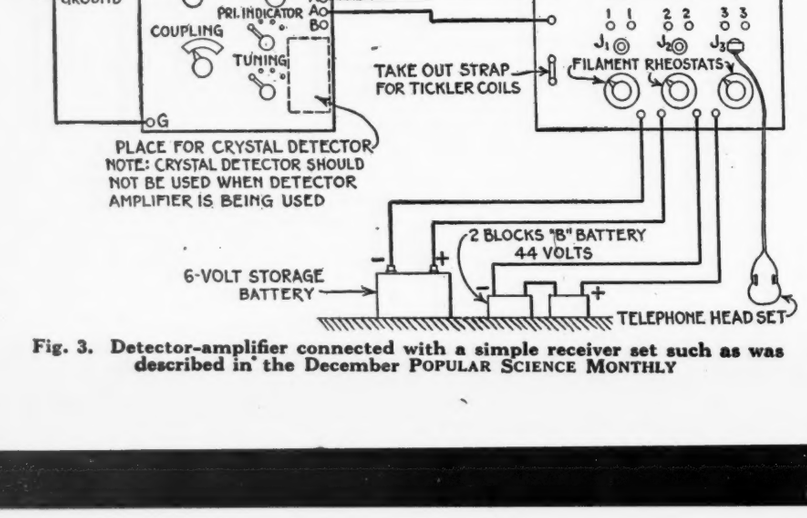


Fig. 3. Detector-amplifier connected with a simple receiver set such as was described in the December POPULAR SCIENCE MONTHLY

How Panel Should Be Mounted

Generally the audion detector and amplifier tubes are mounted on a panel that also carries the coupling transformers, the grid leaks, and shunting condensers. In order to prevent shocks to the table on which the apparatus is mounted from being transmitted to the tubes and then, through the vibration of the tube

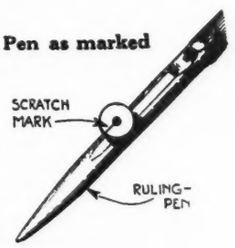
elements, transformed into noise in the telephone receivers, this panel should be mounted on brackets by means of a spring or sponge rubber suspension. The army and navy in some war apparatus found that the sponge rubber mounting was quite satisfactory. Figure 2 shows clearly the details of such a mounting. The binding-posts for filament rheostats and jacks are mounted in the front panel, which can be placed in some sort of a wooden cabinet.

This detector amplifier can be connected with any set of tuned circuits and will receive spark-buzzer modulated or telephone signals very satisfactorily. The detector amplifier connected with a simple receiver set, such as was described in the December number of POPULAR SCIENCE MONTHLY, is shown in Figure 3.

Mark on Ruling-Pen Insures Uniform Ink Lines

BY the simple expedient of making a single scratch mark on your ruling-pen, you can be certain of resetting it to the width of line you regularly use.

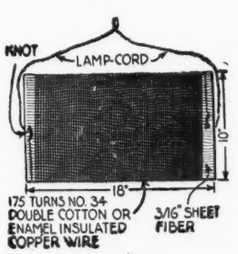
Set your pen for drawing your usual width of line and, by means of a straight edge and a sharp knife, make a mark from the center of the adjusting thumb-nut to the edge in the direction of the point of the pen, as shown in the following illustration.



Adjust your pen to the fine line you ordinarily use for center and dimension lines and note the position of the gage mark. In the same way note its position when the pen is open for drawing heavy border lines. You will then have no future trouble in setting your pen to any one of them, and you will save all the time usually required to make trial adjustments. This insures uniformity and also makes it easy to resume work on an incomplete drawing.—FRANCIS M. WESTON, JR.

Electric Heating-Pad Will Add to Your Winter Comfort

AN electrical heating-pad that will afford much comfort on cold nights can be constructed easily and cheaply. Cut a piece of 3/16-in. sheet fiber 18 in. long and 10 in. wide. In each of the 18-in. edges file 175 notches 1/16 in. deep with a three-cornered file, spacing them equal distances apart, and drill in each of the narrow sides a ¼-in. hole. Then wind on 175 turns of No. 34 magnet wire, either double cotton or enamel insulated, one turn to a notch, and solder the ends to the ends of a length of lamp-cord put through the holes and knotted, as shown. Wrap the whole with asbestos paper and two or three layers of cloth tightly bound with string or strong thread; it may be sewed if desired. An attachment plug at the other end of the lamp-cord completes the outfit for connection with a 110-volt lighting circuit.



Pad with cover removed

Radiator Humidor Keeps Air Moist

MEDICAL authorities and heating and ventilating engineers are more and more emphasizing the necessity for providing the proper degree of moisture in the air of the home during the winter. It is not only more healthful to have the air somewhat moist, but it also tends to save fuel, because the body does not require the excessive amount of heat needed when the air is too dry.

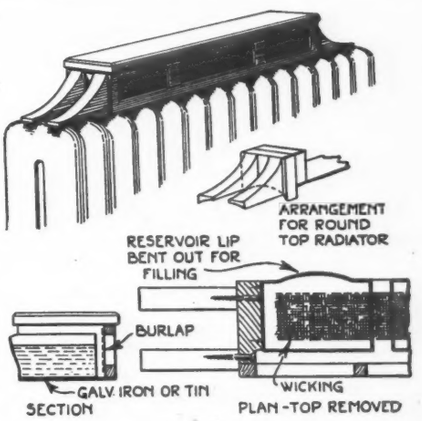
The simplest method of adding moisture to the air is to place a pan of water on the radiator or stove. This, however, is usually regarded as too unsightly in the living-room or dining-room. Even some of the humidors on the market are none too ornamental.

This difficulty of "looks" can be overcome by the home worker at very little cost by constructing a radiator humidor like that illustrated. It is really a shallow box 4 in. wide, 3½ in. high, and of a length to suit the radiator, the one shown being 2 ft. 2 in. over all. This box is open only in the back, the top being screwed or nailed solidly to the ends and front.

The ends are two ¾-in. blocks, 3 in. by 4 in. for radiators with a number of coils and 4 in. by 4 in. for narrow high radiators. Screwed to them are four purely ornamental blocks of ⅞-in. stock, sawed as shown. The front, of ½-in. stuff, is really a light frame, bradded together, and backed with burlap of a color to suit the color scheme of the room in which the humidor is to be placed. The burlap, which will appear as panels, may match the hangings, if dark, or the wallpaper, or the upholstery. The color will help "key" the humidor to the other furnishings and make it seem to have been designed especially for its place. Similarly, the wood should be stained and finished to match the trim of the room.

If your radiator happens to have a rounding top, use two additional end pieces with their bottom edges sawed out to conform approximately to the curve of the radiator. Increase the height of the front frame to correspond and bevel off the under edges of the ornamental blocks, as shown.

The bottom is a strip of galvanized iron or tin. Inside, at each end, are tin water reservoirs, which may be made from any suitable cans, such as hard-candy containers, square asparagus cans, or any kind of dish that suggests itself. Screws or brads at the top of each reservoir hold it in place against the sides. A lip should be bent out so that there will be no difficulty in filling it from behind. A band of burlap



The radiator humidor and its construction

or other porous material is used as a wick and runs from one reservoir to the other, dipping into both. The entire inside of the box, particularly the woodwork, should be heavily coated with red or white lead to protect it from the combined action of heat and moisture. If care is not taken to paint the woodwork thoroughly inside, it will warp and twist out of shape and tend to crack.

Properly made and carefully finished, the humidor will add the requisite moisture to the air of the room without being an eyesore, and the simplicity of its construction will insure its lasting for years.

A Cheap Reflecting Electric Heater

THE reflector of this electric heater is made from an old auto headlight. The base consists of the bell-shaped part of an electric horn, mounted on a square oak block. The reflector is fastened to the horn by means of two metal strips soldered to the back of the reflector and bolted to the horn.

The core for the resistance wire is made from a block of pumice-stone. It is roughly shaped on a grindstone and has a spiral groove cut in it with a round file. A hole is drilled through the center to accommodate a bolt, which holds the core in place. A smaller hole is drilled parallel to this for the wire lead from the heating coil.

The heater assembled

Eighty feet of No. 22 German-silver resistance wire is required for the heating coil. This is wound around a rod ⅛ in. in diameter, so that a long springlike coil is formed, which then is wound on the core in the spiral groove. The heating unit is then bolted to the reflector and insulated by two mica washers which can be made from the mica cover of an old fuse-plug.

The parts for this heater can be obtained at a garage for less than a dollar and the resistance wire and flexible cord can be bought at an electric shop. The heater will draw about 4 amperes on a 110-volt circuit. It will be particularly serviceable wherever a portable heater is required.—WALTER E. BURTON.

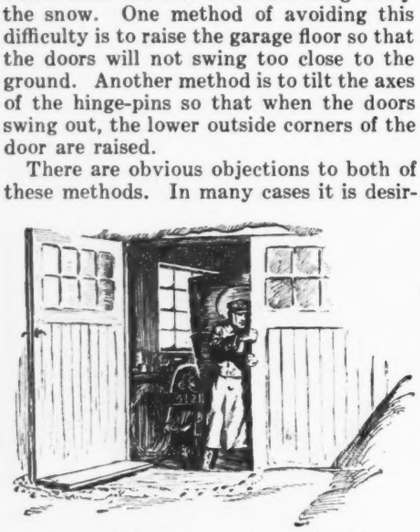
Address Your Letters to The Home Workshop

All contributions, questions, and correspondence intended for this department should be clearly addressed to the Home Workshop Editor, Popular Science Monthly, 225 West 39th Street, New York City. Please take care that both your communication and the envelope are so directed.

Opening the Garage Doors in Snowtime

WHEN snow lies deep on the ground, it is difficult to open swinging garage doors wide without first shoveling away the snow. One method of avoiding this difficulty is to raise the garage floor so that the doors will not swing too close to the ground. Another method is to tilt the axes of the hinge-pins so that when the doors swing out, the lower outside corners of the door are raised.

There are obvious objections to both of these methods. In many cases it is desirable to have the doors quite close to the ground because it is cheaper to have the garage floor flush with the ground as well as easier to drive in and out. In order that the doors may swing within an inch or so of the driveway and yet be opened easily when there has been a heavy fall of snow, it is suggested that the lower part of the door be hinged so that it will swing up out of the way. A small block placed in the floor in the center of the doorway will act as a stop to prevent these hinged members from opening inward when the doors are closed.



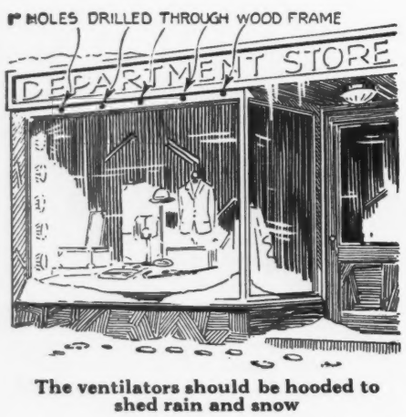
A hinged bottom member makes the doors easy to open

Preventing Frost Forming on Store Windows

DURING cold weather many retail merchants lose the effect of their window display by allowing their shop-windows to become covered with frost.

The covering of frost is due to the change in temperature in the window space. The remedy lies in having the space inside the windows cold all day. Back windows which partition the window space from the store itself help, but are not sufficient.

Several small holes should be drilled in the top and floor of the window space to connect it with the outside. About three holes, each 1 in. in diameter, are sufficient for a window of average size. These holes allow the outside cold to penetrate, and equalize inside and outside temperatures.



The ventilators should be hooded to shed rain and snow

Bench Talks

Translate Your Idea into the Language of Pictures Before You Begin Work

By Arthur Wakeling

MANY a man have I seen begin some interesting bit of work in his home workshop—cellar, attic, or wherever it happened to be—with lots of enthusiasm and "pep" and carry it along well for a certain distance only to meet with obstacles that transformed his pleasure to disappointment. He either bungled his way through to the bitter end with a grim resolve not to tackle something so difficult the next time, or he quit cold. In nearly every case this failure was quite unnecessary and could have been prevented by a few pointers from an experienced workman.

After all, success in the home workshop is no secret. It is mainly a matter of having a definite course of procedure that will carry you, by clear and certain steps, through to the end.

I usually start with a sketch of my basic idea. Drawing is the universal language of the workshop, just as it is the medium in which the designer, engineer, and inventor express themselves. Through sketching, I "think out" my problems in construction.

But I don't throw down my pencil just as soon as the sketch is done. If it is something complicated I am to make, I prepare a working drawing, full size if possible. It is not time lost, but time saved. I have always noticed that the better the mechanic the more certain he is to provide himself with a working drawing, no matter how rough or fragmentary it may be. Whenever any of my friends take me to see their workshop or workroom, I expect to see a drawing-board and T-square just as surely as a bench, hammer, and saw.

From the drawing I prepare my bill of materials as accurately as possible. It doesn't pay to leave anything to good luck or to take a chance on finding odds and ends to complete the object after it is half done. I've seen so many instances where plans should have been modified in the very beginning to suit the materials actually available rather than those that the ever optimistic home worker had hoped to get.

When I'm ready to start getting out the stock and preparing the materials and parts, I simply follow the routine that would be used in a regular shop. It's a matter of getting out all similar pieces at the same time; completing one operation at a time, whether it is planing, turning, drilling, sawing, or anything else; doing as much as possible with one setting of the machine or tool before changing it for another operation; keeping the various units grouped in an orderly manner in the workshop, and, finally, devoting undivided attention to each individual process, as if the final success depended—as, indeed, it largely will—upon the preparatory work.

I shouldn't think of beginning to assemble the parts piecemeal unless there were some special reason, such as might arise in experimental work. I leave the putting together of the parts until I am free of all the preparatory work and can devote my attention entirely to the one thing. I don't want to have to stop to hunt for anything, and to find that some important detail had been overlooked would quite spoil the day for me.

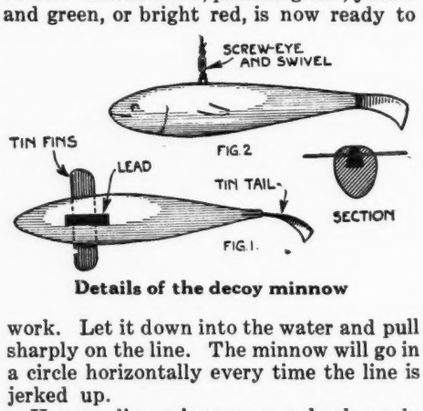
Take, for example, a library table I made recently. After I had roughly sketched the design, made a working drawing and a list of materials, and had everything at hand, I got out the pieces for the top and glued them up, dressed and shaped the legs, prepared the rails and got ready the pieces for the drawer. Then I put the table and the drawer together, fitted the drawer, put on the hardware, and the job was done with the exception of the finishing.

Make a Decoy Minnow for Ice-Fishing

IN February when ice fishing is at its height much pleasure and success may be had by using a decoy minnow such as is shown in the illustration. The best place to use this minnow is inside a fish house over a hole in the ice, where everything is dark and the depths below can be seen.

The decoy minnow is made of some dry, light wood, preferably sumac. The minnow's body should be shaped slim, like a perch, 4½ in. long. A deep pocket is dovetailed into the wood as shown and a slit is made through the sides to admit the tin piece that forms the fins. These fins should stand out straight away from the body and should be at least ½ in. wide and extend nearly ¾ in. from the body. When this piece has been worked through the slit, the socket is filled with melted lead, which works under the fin and locks it in place. The tail, also of tin, is bent as shown and worked into a slit made to receive it. It can then be fastened with brads and bound firmly with a fine wire.

Insert a screw-eye in the back of the minnow at the balancing point and attach the line by means of an ordinary fishing swivel. The minnow, painted green, yellow and green, or bright red, is now ready to work. Let it down into the water and pull sharply on the line. The minnow will go in a circle horizontally every time the line is jerked up.

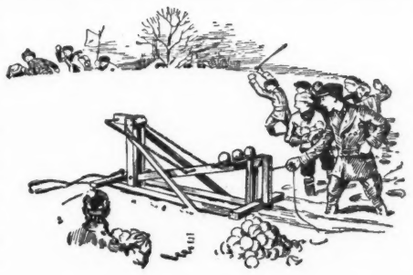


Details of the decoy minnow

Have a live minnow on a hook ready in your minnow pail and when a fish appears edging up to the decoy, pull it up and let down the live minnow. The result will be an almost instant capture.

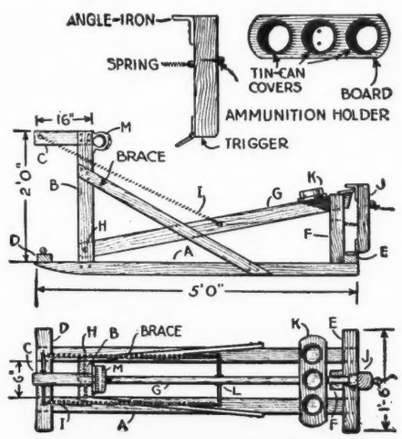
The reason the decoy minnow is used is that it can be seen at a far greater distance in the water than a live minnow.

Heavy Artillery for a Snowball Fight



ARMIES with the most improved engines of war usually win. So with snow battles. The "army" that first attacks with the snowball cannon described below and follows up with a massed attack of infantry, will force the "enemy" to surrender.

The base *A* consists of two pieces 2 in. by 4 in. by 5 ft., planed smooth and one end of each tapered. One foot from the tapered ends bolt two vertical pieces, *B* (2 in. by 4 in. by 2 ft. 2 in.) to the inside of the bases,



Construction of the snowball cannon

which should be laid parallel and level. With four bolts, bolt *C* (2 in. by 4 in. by 1 ft. 4 in.) horizontally between the tops of the two pieces. This brings the two pieces *A* about 6 in. apart. Then bolt cross pieces *D* and *E* (1 ft. 6 in. long) to each end so the pieces *A* will be exactly parallel. Two braces should be bolted to the sled from *B* down to *A*, as shown, to keep the upright *B* rigid and vertical.

The sling or catapult *G* is a piece of ⅞-in. oak or ash board 4 in. wide and 4 ft. 3 in. long. Pivot this freely between the two uprights *B*, using a carriage-bolt with pieces of rubber hose for washers. A long bolt is driven through the end of *C* and another through *G* 2 ft. 3 in. from the pivot. Secure them in place with washers and locknuts and connect the ends of the bolts securely with a pair of strong spiral springs, as shown. These must be strong, of equal tension, and of a normal length to raise the lever *G* nearly upright.

The trigger *J* is made of a piece of stout oak or ash about 2 in. square and 15 in. long. Hinge one end to the cross piece *E* with a strap hinge at the upper end, screw an angle-iron as shown, and halfway between fasten a light spiral spring similar to a curtain spring. Tie the pull-cord to a screw-eye at the back of the trigger. Just in front of the trigger bolt the guide *F* to the front of *E*. This is a piece 2 in. by 4 in. by 15 in., with the top end slotted down 2 in. wide for about 6 in. to receive the end of *G*. Attach the free end of the trigger spring to the back of *F* so it pulls *J* forward. A metal plate should be fastened to the end of *G* to engage the angle-iron on *J*. The ammunition holder is a wide board about 15 in. long, with three tin can covers to hold the snowballs. A section of old automobile tire *M* acts as a buffer and a screw-eye in the center of *D* serves to hold the drag-rope.

In action, the rear end is raised or lowered to get the desired firing position, as determined by practice, and the cross pieces are weighed down with snow to steady the cannon.

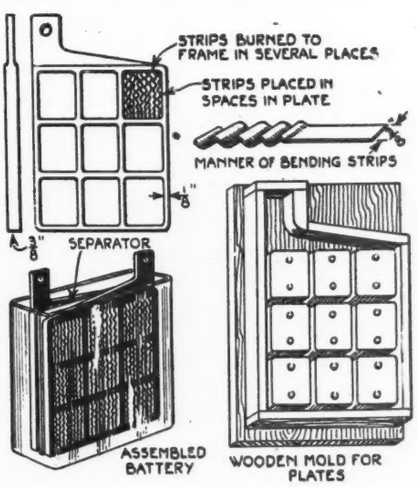
Building a Serviceable Storage Battery

ELECTRICAL experimenters may build a good serviceable storage battery at little cost. One cell should be allowed for every two volts and each cell may contain two or more plates, according to the desired capacity. A two-plate cell will give about 10 amp. for one hour when fully charged if the plates are about 4 in. by 5 in.

The containers may be of glass or hard rubber. Make a wooden mold for the lead framework of the plates as shown, or, if you can obtain molding-sand, mold them from a wooden pattern. The plate should be ⅜ in. thick when finished. Provide a quantity of sheet lead 1/16 in. thick. Cut this into strips ⅜ in. wide, bend as shown and press into the spaces in the plates, honeycomb fashion.

The plates are then ready to be "pasted." You will need some sulphuric acid, red lead, or litharge. Six ounces of the latter will be sufficient for six or eight plates. Mix the acid with ten parts distilled water and enough of the litharge to make a thick paste, which is pressed into the spaces in the plates. Enough for only one plate should be mixed at a time, as it sets very quickly. The plates are then baked in an oven until hard.

Curing is accomplished by wetting the plates several times and allowing them to


STRIPS BURNED TO FRAME IN SEVERAL PLACES
STRIPS PLACED IN SPACES IN PLATE
MANNER OF BENDING STRIPS
SEPARATOR
ASSEMBLED BATTERY
WOODEN MOLD FOR PLATES

How to mold and assemble battery plates

dry. The first time they should be merely sprinkled with the diluted acid. As the acid has considerable effect on the uncured plates, they must be wetted gradually. After being sprinkled and dried, the plates may be quickly dipped again and, when dry, dipped for a longer time. Increase the period of dipping till the acid has no further effect, after which the plates are ready for charging and may be assembled in the cells. Wooden separators about 1/16 in. thick are placed between the plates.

Obtain regular separators if possible, for the cost will be trifling. If you make your own, use thin wood perforated with 1/16-in. holes.

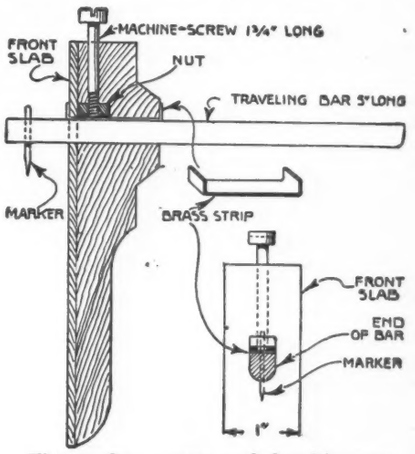
Use direct current for charging. For a 6-volt battery the charging voltage should be from 8 to 12 volts. Fill the cells with acid mixed to test 1100 with the hydrometer, and use nothing but distilled water. After being charged the first time, the positive plate will turn a reddish brown.

The battery will not work at full strength until after being charged and discharged a few times. You can use a charging current of 4 amp. to start and 2 amp. to finish. The acid should test 1300 when fully charged. If the battery is to be moved around, the tops must be sealed up and the plates fastened securely so that they will not move.—HARRY L. GRAY.

Make This Handy Gage for Your Workshop

HERE is a useful little gage that will remain set in any desired position and is easily made.

Select a clean, straight-grained piece of maple and cut it to the pattern shown. On



This makes a neat and durable gage

the finished flat surface center 1¼ in. from the end and bore a ⅜-in. hole through the block. Trim the top of the hole square with a chisel.

Through the end of the block drill a 3/16-in. hole down to meet the cross hole, and where it meets it, chisel out a recess to hold the nut of the machine bolt that passes through it. Glue the front slab on, perforate it at the cross hole, and then bend a piece of brass, as shown, to slip through the cross hole and hold the nut in place.

Shape the traveling bar to fit the hole snugly and drill a fine hole ¼ in. from the end for the marker, which is a piece of steel umbrella rib filed to a point. By tightening the screw the bar will stay firmly in any position.

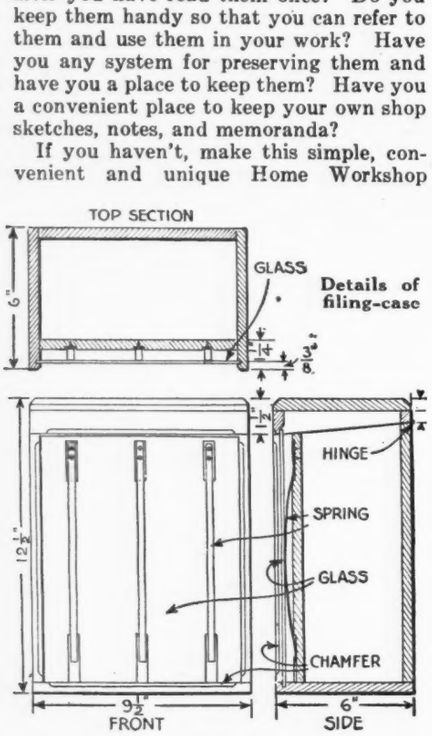
When stained and polished, this is a handsome little gage.—L. H. KIRBY.

DENTS can be removed from the fenders or body of an automobile by using a pillow of sand. Fill a canvas sack with sand, fasten a board to one side, and place the soft side against the cavity. Then hammer the ridges with a wooden mallet or a soft hammer.

A Filing-Case for Your Home Workshop

WHAT do you do with the good ideas that appear in the Home Workshop after you have read them once? Do you keep them handy so that you can refer to them and use them in your work? Have you any system for preserving them and have you a place to keep them? Have you a convenient place to keep your own shop sketches, notes, and memoranda?

If you haven't, make this simple, convenient and unique Home Workshop



Details of filing-case

filing-cabinet. It has been specially designed for holding the clippings that you may cut from POPULAR SCIENCE MONTHLY in case you do not wish to preserve the

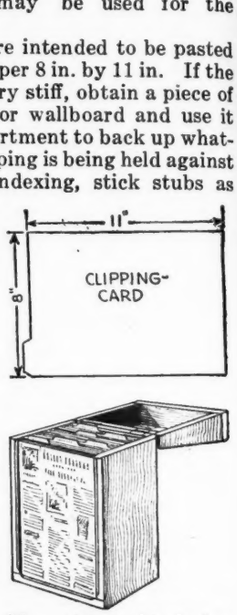
Using the cabinet

entire magazine. It will be equally useful, however, for holding your own sketches and notes.

The unusual feature of the case is the glass front, against which the drawings from which you are working are held by spring clips. You can keep your working data right before you all the time, and the clipping or sketches won't be soiled, torn, mislaid, covered up or in the way on the bench. You all know how a sketch looks after it has knocked around the workshop for a few days or weeks. Often it is quite illegible and it usually manages to get under a board or among the shavings or in some crowded drawer—the last place one ever thinks of looking for it.

The dimensions and method of construction are fully shown in the working drawing, although the depth may be increased according to the amount of material you expect to keep on file. The cover can be sawn off after the box has first been tacked together. Pieces of clock-spring or any clips available may be used for the springs.

The clippings are intended to be pasted on cards or stiff paper 8 in. by 11 in. If the mounts are not very stiff, obtain a piece of heavy cardboard or wallboard and use it in the front compartment to back up whatever sketch or clipping is being held against the glass. For indexing, stick stubs as shown to the back of the cards. You can select your own subjects for indexing, according to your interests. For instance, you might have a group of clippings about electrical devices, another about tools, another about furniture or woodwork, another about auto repairs. Use the headings that will be of most service to you.



Mounting and indexing clippings

The finished case, whether stained or painted, will be a distinct addition to your workshop fittings and you will find that it will give valuable service.

Alarm Clock Regulates Drafts and Dampers

By E. J. McGinniss

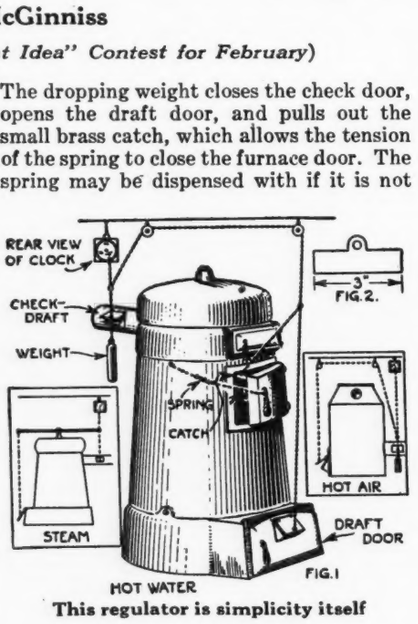
(Awarded First Prize in the "Best Idea" Contest for February)

TO most of us, who must crawl unwillingly from under warm covers, the most uncomfortable part of a winter's day is the early morning when, still shivering, we journey down to the cellar to fix the furnace. Here is the solution that will make it possible to arise in a room that is warm and comfortable.

The control apparatus illustrated is easily adaptable to any make of furnace or heater, whether hot water, steam, hot air or pipeless, and can be installed in an hour's time at a cost not exceeding $3.00. Figure 1 shows it attached to a hot-water heater. All that is needed is a length of small tiller chain, such as can be purchased at a naval supply store, or any other small chain, two pulleys, a lead weight of from 6 to 8 lbs., one ordinary alarm-clock, a door-spring, and a small brass catch as shown in Fig. 2. This can be filed and drilled from ¼-in. sheet brass.

The alarm-clock is enclosed in a box having a hole that allows the chain to pass through. The box is hung on a chain directly above the check-draft door. A section of chain is attached to the door and to the key for winding the alarm. The chain should have a small hook attached so that it will be thrown off when the key revolves.

There is another small piece of chain attached to the door-spring and to the furnace door and furnace. When the alarm goes off, the key turns, releasing the chain. The dropping weight closes the check door, opens the draft door, and pulls out the small brass catch, which allows the tension of the spring to close the furnace door. The spring may be dispensed with if it is not



This regulator is simplicity itself

customary to keep the feed door open during the night.

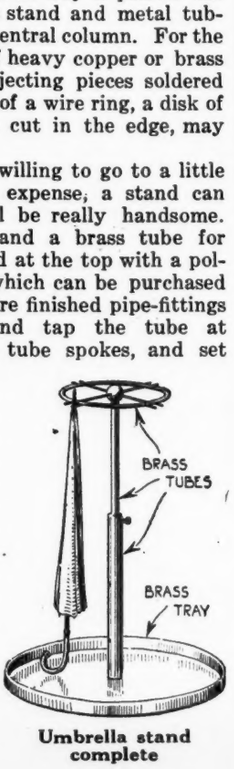
The regulator can be used at any time of the day. If, for example, you go out for the day, and want a warm house on your return, all that is necessary is to attach the hook to the alarm key in such a way that the key is in a horizontal position to allow the catch to drop. The clock will do the rest.

Keeping Umbrellas from Rusting

IF umbrellas, when wet, are placed to dry handle end up, so that the water runs down to the point, the ribs will rust and the cloth rot.

Use a big sheet-metal tray or pan for the bottom part of this stand and metal tubing or wood for the central column. For the top, make a ring of heavy copper or brass wire with the projecting pieces soldered in place. Instead of a wire ring, a disk of wood, with notches cut in the edge, may be substituted.

If the builder is willing to go to a little extra trouble and expense, a stand can be made that will be really handsome. Use a brass tray and a brass tube for the upright, finished at the top with a polished brass knob, which can be purchased from any shop where finished pipe-fittings are sold. Drill and tap the tube at the top for brass tube spokes, and set the outer ends of the spokes into holes drilled part way through the ring or rim, which may be of heavy square brass or copper. Or, if desired, tubing may be used for the ring. The projecting prongs may be screwed into the outside or "ears" riveted in place with round-headed copper rivets.



Umbrella stand complete

Making a Child's Roomy Playhouse from Wallboard

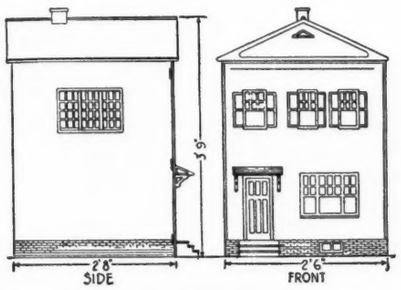
By A. Evans Elling

THIS child's realistic and roomy playhouse will keep the children happy for hours at a time indoors during the bad weather of the winter months and in the sunny days of spring and summer it can be carried to porch or lawn for endless games of "playing house."

The home worker will find this house easy to construct and it may be made better looking than many of the expensive playhouses for sale in toy-shops. It is constructed of any plain standard wallboard with either smooth or pebbly surface on both sides.

The tools required are a hammer, saw, try-square; ¾-in. and ⅜-in. chisels, screwdriver, and plane. A large square and a miter-box with a square cut in it will also be useful.

The materials required are two 4 ft. by 8 ft. wallboard, or the equivalent; about 75



Side and front of playhous

lin. ft. of 1 in. by 2 in. common building lath; a few pieces of ⅞ in. and ¼ in. stuff, good and clear, to make the corner strips, lattice, window-frames, chimney, etc.; and two large angle-irons or shelf brackets and screws. If the house is to be taken apart again, provide about a dozen small angle-irons and screws. Three narrow butt hinges about 3 in. long, with screws, 3½-in. finishing nails for nailing frames together, and other finishing nails and brads as required will also be necessary.

Make the four frames of the lath, as directed in Fig. 1, three 2 ft. 6 in. by 3 ft., and one 2 ft. 6 in. by 10½ in., outside measurements. If you have a piece a little heavier—say 1¼ in. by 2 in.—use it for the brace, Fig. 2, but do not cut the notches at the ends until ready to assemble. The regular lath will do for the floor brace, Fig. 3, which will be 2 ft. 4¼ in. or 2 ft. 4 in. long, according to the thickness of the frame material, which will be either ⅞ in. or 1 in. It lies flat on the floor. Screw on the angle-irons as shown.

On a sheet of paper or a board lay out the pattern for the two roof frames, Fig. 4. Place pieces of lath on the pattern and cut with care and exactness to the lines as shown. Do not cut the notches at the ends until assembling. Nail the frames together and screw a small metal brace across the tops.

After squaring all the frames so far made, nail on each one temporarily two strips of wood as braces to keep them in shape. Then nail the frames together, letting the back frame and the door-frame overlap the sides, as shown in Fig. 5. Do not drive the nails in fully, as they are to be drawn out again later. Keep the door-frame ½ in. off the floor. Next, screw in the top brace, Fig. 2, keeping it 1 in. back from the inside of the door-frame, as shown in Fig. 6. Screw the floor brace close against the

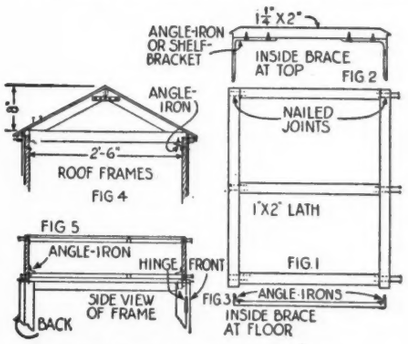
After the winter is past, the playhouse will still provide endless fun

inside of the door, using the small angle-irons shown in Fig. 3.

Place the roof frames in position, as shown in Fig. 5. Now measure carefully the distance between and cut off two laths, one for each side, as shown more fully in Fig. 6. Cut the top or ridge of a little heavier material, if at hand, beveling the top edge to the angles of the roof. Nail the two roof-frames to these three pieces and add angle-irons as shown in Fig. 6. Brace this well on the inside temporarily.

Screw in small angle-irons to secure the back to the sides and the sides to the roof-frame. Let the door-frame remain nailed on for the present, but draw the nails from the back.

Lay some boards on saw-horses or boxes



Details of frames and braces

and place the wallboard on top. Mark out every piece required so as not to cut to waste. With a fine-toothed cross-cut saw, cut the wallboard as close as possible to the edge of the board underneath.

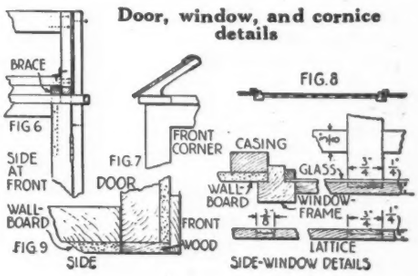
You will need the following: 3 pieces 2 ft. 6 in. by 3 ft. for sides and back; 1 piece 2 ft. 6 in. by 2 ft. 10½ in. for door; 2 pieces 1 ft. 7 in. by 3 ft. for roof; 1 piece 9 in. by 2 ft. 6 in. for upper front angle.

The rear angle, corresponding to the last item, is left open above the eaves for ventilation, although it may be filled with lattice work. Now nail all except the door in place, using nails that do not come through on the inside.

Take four pieces of 1 in. by 1⅛ in. strips to go all around, under the eaves and across the back and over the door. Make four pieces, Fig. 9, the same thickness as the wallboard and as wide as the thickness of the frame and wallboard combined, that is about ¼ in. by 1⅛ in. and 3 ft. long. Nail these on the edges of the door and the back frame. Then take down the door frame and attach the front wallboard to it.

Two pieces ½ in. by 4 in. should be nailed on as shown in Fig. 7 and ⅞-in. pieces cut out with curved ends—Fig. 7 and front view. The ridge board is made of two

Door, window, and cornice details



pieces or a round grooved strip, as shown.

Hinge the door, keeping the top tight under the 1⅛-in. piece. A small caster at the corner, which swings around, will take care of the drag if the children put their weight on the door.

Make the side window-frames 8 in. by 12 in. outside, as shown in Fig. 8. Use ½-in. by ⅞-in. strips for the inside frames, which should be glued and bradded before cutting out the wallboard for the opening. Then miter together the outside frame, which should be of ⅞-in. square strips rabbeted on both edges.

Make the lattice of ¼ in. by ¾ in. and ¼ in. by ⅜ in. pieces halved together or made of strips glued to the glass. The chimney, door-hood, door, steps, and other details may now be made or the effect secured by painting these architectural features as realistically as possible.

Where to Buy Special Parts

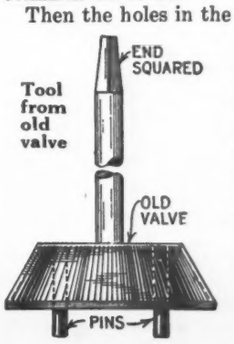
HOME workers who must buy special parts, materials, or tools, will often save themselves time and trouble by looking up the display and classified advertising in POPULAR SCIENCE MONTHLY. If the items desired are not listed in the advertisements, send a letter of inquiry to the Editor, enclosing stamped, self- addressed envelope. You will promptly be furnished with a list of places where the articles may be obtained.

Valve-Grinding Tool

ONE of the simplest valve-grinding tools the writer ever saw was made from an old valve in the manner illustrated.

The end of the shank actuated by the push-rod was tapered and squared to fit a common bit-stock.

Then the holes in the valve itself, where the points of the ordinary valve-grinding tool usually fit, were drilled clear through and a steel pin driven in each one so that about ⅛ in. of the pin projected from the top face of the valve. The ends of the pins were slightly rounded. —L. B. ROBBINS.



Let This Air-Blast Inductor Save Your Fuel

WHAT percentage of efficiency do you get from the heating system of your house?

You probably can't answer that question; in fact, few engineers could figure it out for you, because so little has been done to study the efficiency of the ordinary domestic heating plant. Yet it is now a very important question for the average man, not only from the standpoint of comfort, but also of cost.

It has been estimated that when you go to the cellar and throw coal on the hot-air furnace, you get heat from only 77½ cents worth of every dollar of coal you have paid for. In other words, if coal costs $14 a ton, you waste $3.15 of that amount.

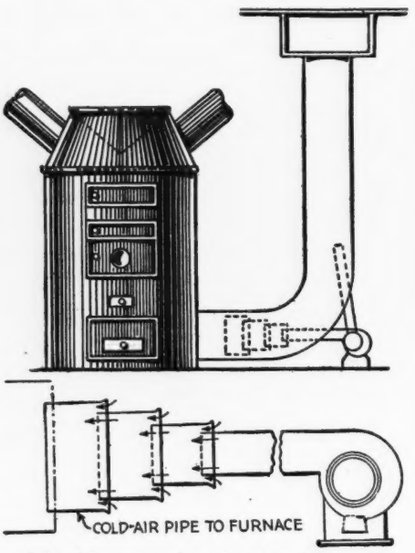
The loss occurs mainly because the distribution of the heat depends upon the difference in gravity of warm and cold air and not upon some direct, positive, mechanical means that will operate whether the fire is bright or banked.

To insure this mechanical circulation of the warm air is, then, the problem. It may be done by arranging an air-blast inductor as shown in the illustration, located at any convenient place between the cold-air inlet and the furnace in such a way as not to interfere with the current of fresh air when the fan is not running.

A small unit will require a blower run by an electric motor of 1/20 horsepower, using when fully "loaded" only 38 watts or approximately 75 per cent of the current needed for an ordinary electric lamp. This would make the cost about ⅓ cent an hour. An ordinary knife, snap, or button switch may be used to control it from any convenient place in the house. The fan runs in almost complete silence and is as near "foolproof" as could be desired.

The value of the device is twofold—it keeps the warm air in motion through the house when the furnace is banked in such a way that the air would not circulate by itself; and it saves having to "force" the fire and waste coal in very cold spells. In weather between the two extremes, when the heating plant normally gives entire satisfaction, there is, of course, no need to use the fan.

In the morning the house can be heated with the aid of the inductor, it is claimed, in from one half to one quarter the time usually necessary, and it will overcome most of the defects common to the hot-air furnace. The coal saved in one season is said to be sufficient to pay for the installation, especially if the man of the house is enough of a mechanic to undertake the work himself.



This blower makes the circulation of warm air positive and certain, even if the fire is low

February Prize-Winners

Prizes in the "Best Idea" contest have been awarded for February as follows:

First Prize of $35

To E. J. McGinniss, of Philadelphia, Pa., *"Alarm-Clock Regulates Drafts and Dampers,"* on page 88.

Second Prize of $15

To Francis M. Weston, Jr., of the United States Naval Air Station, Pensacola, Fla., *"Mark on Ruling-Pen Insures Uniform Ink Lines"* on page 85.

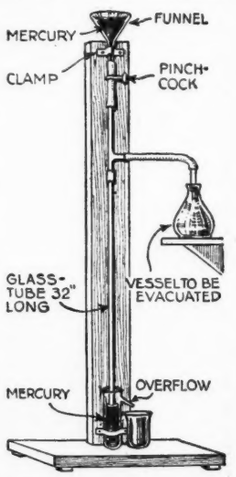
Final awards in the present monthly contest will be made next month and at the same time announcement will be made of a new contest along similar lines.

Homemade Vacuum Pump for the Laboratory

IN describing this simple little pump, built on the Torricellian principle, we will start at the top of the device and work down.

A small glass funnel is attached to the top with a clamp. A rubber tube connects the end of the funnel with a glass T, which may be obtained at any chemical supply store.

Vaseline is then smeared over the glass above the rubber and the tubing bound tightly with thread. The opposite end of the glass T is connected by rubber tubing with another piece of glass tubing, 32 in. in length. This should have a bore of about ⅛ in. The end of this tubing dips into a tabulated test-tube placed below and filled with mercury. When the mercury reaches the level of the side tube, it will flow out into a beaker.



The vacuum pump in use

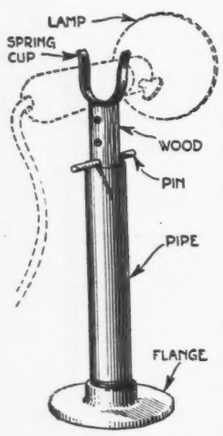
The bottom of the glass tubing should always be below the mercury level, or, in other words, the overflow tube. The vessel to be evacuated is connected with the free end of the T by heavy tubing as shown.

A chemical pinchcock is placed on the rubber tube between the funnel and the T. A few ounces of mercury are poured in the funnel. The pinchcock is opened repeatedly and a number of drops of mercury are allowed to pass through the long tube to the mercury receptacle below. The mercury should not be allowed to stream through. Each little mercury drop will act as a piston and will force the air before it, making the air more rare in the vessel to be evacuated.

If this operation is kept up long enough a very high vacuum will be produced. The funnel at the top should always be kept with some mercury in it to act as a seal.

Adjustable Repair-Lamp

FOR repairs that are more or less inaccessible and difficult to see, such as is frequently the case when working on automobile engines, the home worker will find this adjustable stand for his portable electric lamp or flashlight of great assistance.



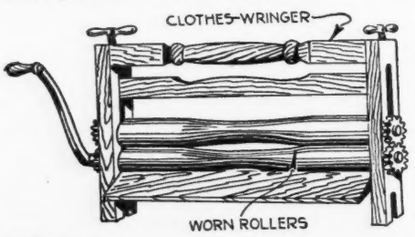
Directs the light where needed

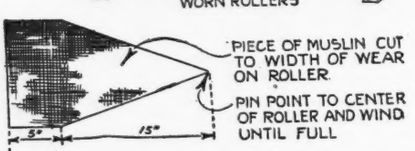
The support is simply a piece of pipe screwed into a flange large enough to serve as a firm base. A round wooden stick slides inside the pipe and may be adjusted to various heights by means of a series of holes and a movable pin. A spring clip secured to the top of the stick forms the holder for the lamp handle.

Repairing Worn Wringer-Rolls

MY wife had complained that her clothes-wringer would not do good work because the rolls were concave. I put on a long strip of heavy muslin by cutting one end to a point, pinning the point to the center of the rubber roll, and winding until the hollow in the roll was filled up.

Do this on both rolls if they are hollow. The expedient has long been giving satisfactory results.—J. B. BIRCHLER.

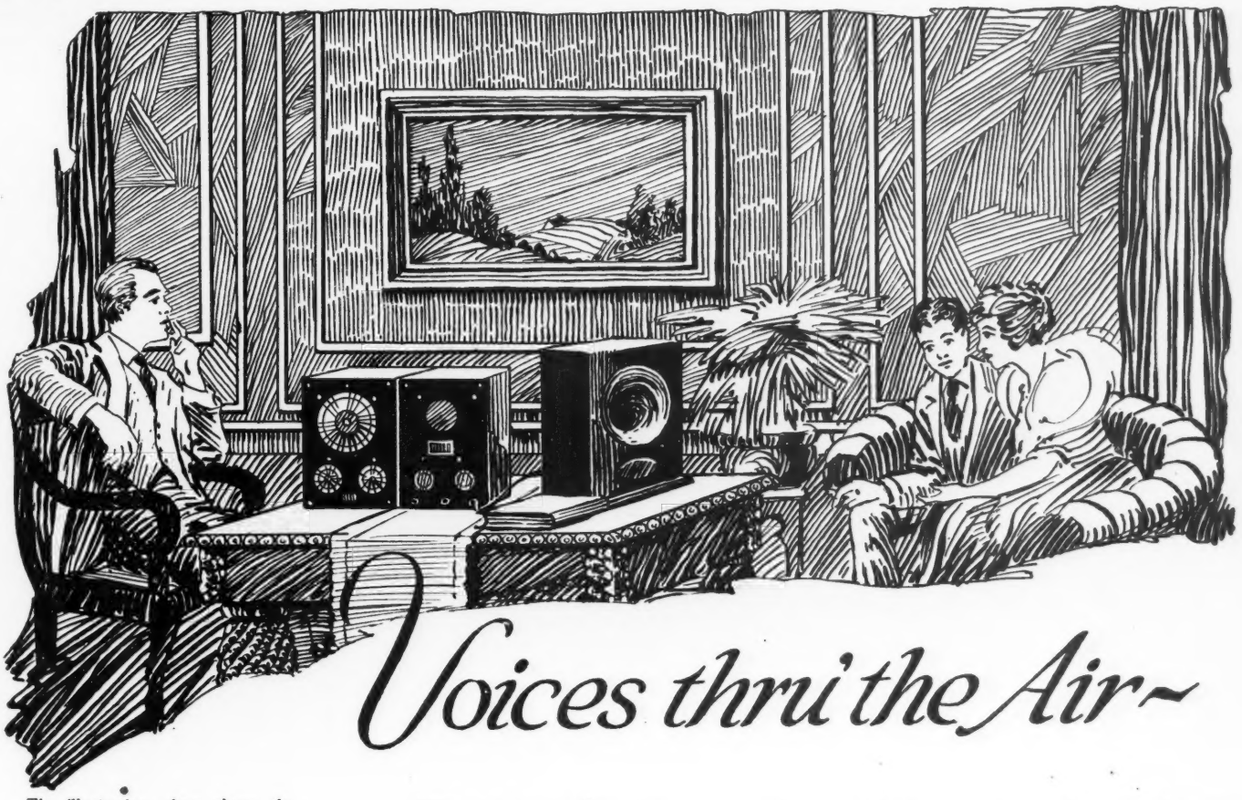




A muslin bandage fills the hollows

Interested in Wireless?

READ the instructive article by Mr. Arnold Holmes in the March POPULAR SCIENCE MONTHLY, on "Receiving Continuous-Wave Radio Signals."



Voices thru the Air~

The illustration above shows the Vocaloud "loud speaker" attached to two Westinghouse instruments so that every one in the room can clearly hear the words and music.

Do you realize that scores of wireless telephone stations are broadcasting on a regular daily schedule, and how easily you can enjoy them right in your own home?

News ahead of the newspapers, concerts by talented artists, sporting results play-by-play, dance music, speeches, weather forecasts, correct time, and other intensely interesting special features—not in dots and dashes—but in actual words and music!

Compact, inexpensive receiving sets have been so perfected that you can listen to the

Wireless Telephone

just like listening to your phonograph or ordinary telephone. You don't have to have any knowledge of the theory of wireless. You need no license nor previous electrical experience. Simple, safe, certain!

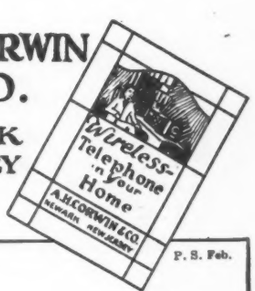
The modern wireless telephone is not a toy—it is an entirely practical sport, science and recreation combined! You can put a complete station in a corner of your living room. No high-power electrical current, no danger whatsoever. A child can operate it successfully.

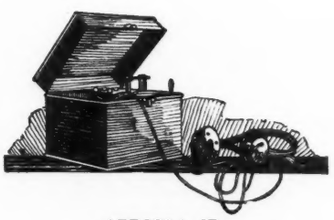
We have prepared a story in book form, "The Wireless Telephone in Your Home." Half the book is devoted to a simple non-technical explanation of modern wireless—invaluable information whether you ever own a wireless set or not. The other half illustrates in detail modern "ready-to-operate" wireless telephone sets of all leading makes, some as low as $15.00 complete.

We are glad to put the experience and knowledge of wireless experts as incorporated in this book, at the disposal of the public. But we do ask you for the small sum of 25 cents to share the expense of actual printing and mailing.

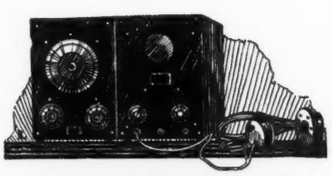
You'll want to keep this book, with its full color cover, and beautiful rotogravure insert on your reading table. Make yourself familiar with the romance of wireless by investing 2 minutes and 25 cents in the coupon below. For additional copies write for Booklet P.

A. H. CORWIN & CO.
NEWARK
NEW JERSEY



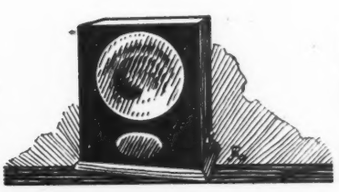


AERIOLA JR.
The new Westinghouse radio receiver. Specially designed to receive the broadcasting. Normal range 40 to 50 miles. Complete with phones in compact case, $25.00. Antenna equipment $2.00 extra. Immediate shipment.



WESTINGHOUSE R. C. SET
A highly efficient instrument for receiving much longer distances. Consists of two cabinets, the Tuner and the Detector-Amplifier. These may be secured one at a time at $65.00 each, or the complete set in one cabinet for $125.00.

"MARVEL" SET
One of the simplest. lowest-priced good sets on the market. Requires no batteries, no current, no extras. Complete with full instructions, ready to set up, for $15.00. Order direct from this ad if you prefer. Delivery at once.



VOCALOUD
Sooner or later you will want to add this sensational loud speaker to your set, so that everyone in the room can hear the words and music. Unlike other types it requires no batteries, no adjustments, no extras.

A. H. CORWIN & CO.,
Newark, N. J.

P. S. Feb.

Send me by return mail your new book just off the press, "Wireless Telephone in your Home." I enclose 25 cents (stamps or coin) to share cost of printing and mailing.

Name .....

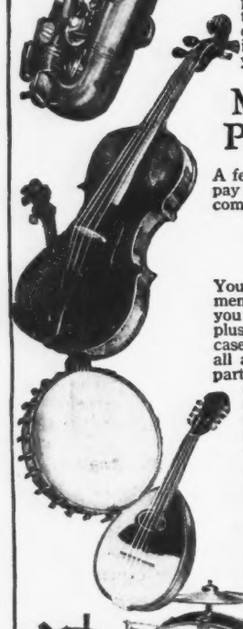
Street .....

City..... State.....

WURLITZER
200 YEARS OF MUSICAL INSTRUMENT MAKING

Your Choice On Trial

WURLITZER will send you *any instrument* with complete outfit for a week's Free Trial in your own home. No obligation to buy. Return the instrument at our expense at the end of the week, if you decide not to keep it. Trial won't cost you a penny.



Monthly Payments

A few cents a day will pay for instrument and complete outfit.

Complete Outfit

You get with the instrument everything that you need — velvet and plush lined carrying case with lock and key, all accessories, extra parts, self instructor, music, etc. — all at direct cost, practically for the cost of instrument alone.

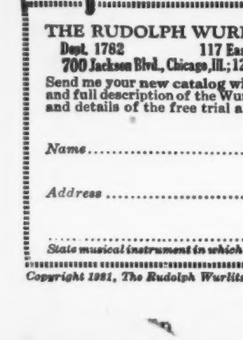
Wurlitzer has made the finest musical instruments more than 200 years.

All instruments including Pianos and Victrolas, are embraced in the Wurlitzer plan.

Send for New Music Book

No Charge

Every known instrument illustrated with prices, monthly payments and free trial blank. Book is absolutely free. Send the coupon now.



The Rudolph Wurlitzer Co.
Cincinnati, Ohio
Chicago, Ill. New York, N.Y.

THE RUDOLPH WURLITZER CO.
Dept. 1782 117 East 4th Street, Cincinnati, Ohio
700 Jackson Blvd., Chicago, Ill.; 120 W. 42nd St., New York, N.Y.

Send me your new catalog with illustrations in color and full description of the Wurlitzer Complete Outfits and details of the free trial and easy payment offer.

Name .....

Address .....

.....

State musical instrument in which you're especially interested

Copyright 1921, The Rudolph Wurlitzer Co.

You May Still Win a Prize in the Contest
"How I Made Money with My Tools"

POPULAR SCIENCE MONTHLY'S prize contest on "How I Made Money with My Tools" ends at 5 P.M., January 20, 1922. Since this number of the magazine is distributed to subscribers and goes on the newsstands about January 10, you still have an opportunity to enter the competition.

Have you ever made extra money with your tools! If you have, we want to know just how you did the trick. If you constructed something, describe it. Tell the story as humanly and as interestingly as possible. Make it as brief as you please, but give the facts accurately and, if possible, illustrate them with photographs or drawings.

Conditions of the Contest

(1) Contestants are not limited in the number of ideas. The contest is open to everybody.

(2) If a drawing is sent in, it need not be made by a skilled draftsman. The contestant's name and address should appear on each sheet of drawings.

(3) Drawings and photographs must be accompanied by a description, preferably typewritten, in which the subject is clearly explained. The MSS. must be written on one side of the paper only, and should not be more than 500 words in length.

(4) Drawings and descriptions entered by contestants must be received by POPULAR SCIENCE MONTHLY not later than 5 p. m., on January 20, 1922.

(5) The judges of the contest will be the editors of POPULAR SCIENCE MONTHLY.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the best idea.

The second prize of $25 will be paid to the contestant who submits an idea next in merit.

The third prize of $15 will be paid to the contestant who submits an idea third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of POPULAR SCIENCE MONTHLY, and their articles will appear later.

(8) The editors of POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts that do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

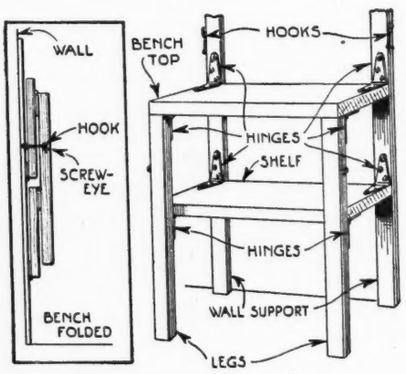
(10) Send drawings and specifications to the Editor of the Making Money with Tools Contest, Popular Science Monthly, 225 West 39th Street, New York City.

Substantial Workbench Folds against Wall

WHENEVER space is at a premium in the home workshop, the small garage, the tire or electrical shop, an extra workbench that will serve for many purposes can be constructed so that it will swing back against the wall entirely out of the way when not in use.

The bench top is hinged at the back to supports fastened to the wall, and at the front to two strong and substantial legs. A heavy shelf underneath, similarly hinged to the supports and the legs, serves the purpose of a brace to hold the bench rigid.

When not needed, the bench is raised against the wall and fastened with hooks and eyes. In that position the under sides of the top and shelf may be used as a bulletin board for drawings, notes, and the like, or, if the bench is in a public garage, for the display of advertising posters.



Construction of bench and how it folds

Home Workshop Blueprints

Please Use This Coupon for Ordering Blueprints from the Home Workshop Service Department

The Home Workshop Service Department,
Popular Science Monthly,
225 West 39th St., New York

GENTLEMEN:

Send me the following blueprint, for which I enclose 25 cents:

No. 1 Sewing- or Work-Table

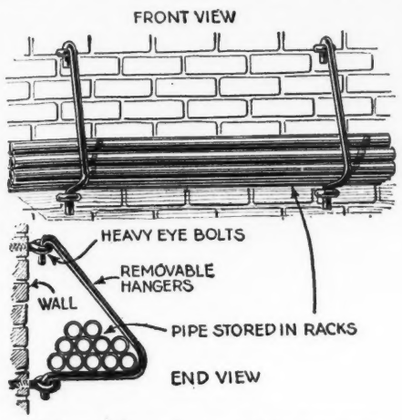
Name..... Street.....

City and State.....

THE HOME WORKSHOP

These Long Storage Racks Take Up Little Room

FIXED storage racks for long articles such as pipes, bars, poles, axles, springs, and similar parts take up considerable space and are more or less an encumbrance in the shop when not in use. Racks less expensive than the usual type, supported solidly from the floor, can be made as shown in the illustration. They have the advantage of being easily removed or of being swung against the sides of the wall.



Adjustable and removable hangers

To make these racks, eye-bolts are screwed into the wall, one above the other. A V-shaped hanger is then made from a bar of wrought iron forged so as to engage the eye-bolts. These supports take up little room and may be shifted about as desired. When the wall is fitted up with eye-bolts the racks are adjusted readily for length by inserting hangers where required.

Shaper Tool Cuts Oil Grooves with Closed Ends

TO cut open-end oil grooves in bushings on the shaper is a simple matter, but it is necessary afterward to stop up the ends with small tapped plugs or solder.

This second operation may be avoided by using a modified tool for cutting the oil grooves. It is made from a steel cutting bar or one tipped with cutting steel and fitted with a roller, and a toolpost holder with a spring strong enough to hold the tool in the normal position for cutting. Two small blocks with beveled edges are bolted to the bed of the shaper in such positions that they will engage and raise the roller and consequently depress the cutter at each end of the groove.

The one tool will serve within limits for cuts of various lengths and the beveled blocks can be adjusted to suit.

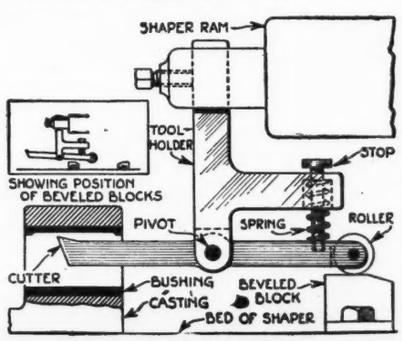
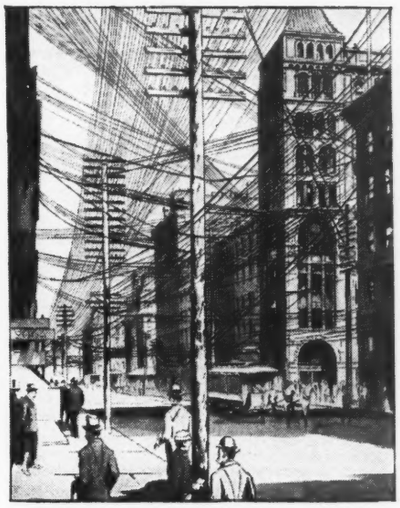


Diagram of tool



A scene on Broadway, New York, in 1890, showing the density of overhead wires

The same scene after the overhead wires were replaced by underground cables

Improvements

The history of the telephone is a record of constant improvement. Only by numerous inventions and ceaseless research for new and better ways has the present standard been reached.

Two-score years ago the telephone could hardly carry the human voice across a city. Now it carries it distinctly across this great continent. The once familiar network of overhead wires in large cities has been replaced by systems of underground cables, each cable containing thousands of slender, sensitive wires.

Switchboards, once primitive devices, called upon to handle only a few connections and limited in their workings, have now become great and precise mechanisms through which the volume and complexity of telephone traffic is handled with mechanical perfection.

With the continued growth in the number of telephone users, there is a continued increase in the problems of speed, accuracy and speech transmission.

These are the problems forever before the scientists and engineers of the Bell System; and the solution of these problems, in advance of necessity, is the objective of this great body of specially trained experts.

The Bell System will continue the improvements necessary to maintain its standard of service, which is the best and cheapest telephone service in the world.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service

"Listen In" to the World's News by Wireless in Your Own Home

With Our **LITTLE WONDER** Portable Radio Set the practical, complete Radio Receiving Outfit now obtainable at a price within the reach of all.

Simple to install and operate. No special knowledge necessary. Complete instructions with each set.

Mr. J. J. Garmston of Short Beach, Conn., says:

"I am very glad to say that your Type S8 Wireless Set is the best set I have ever had that tuned to 800 Meters. . can pick up my phones any time in the day and there are always some messages coming in. I hope that if I get any more supplies from you they will give as much satisfaction to me as the Type S8 Set has given."

Mr. J. F. Wilke of East View, N. Y., says:

"I have one of your receiving sets Type S8 and have had wonderful results."

Type S8 (as illustrated) price..... $7.50

Type S8-B complete with sensitive double head phones and complete aerial equipment (ideal for wireless telephone reception)..... $15.00

Postpaid in U. S.

Buy from your dealer or order direct from us.

RADIO SERVICE CO.

Manufacturers of Complete line of Radio Apparatus

Suite 1602, 110 West 40th St., New York City, Factory: Lynbrook, L. I.

Easy to Play
Easy to Pay

Donald Clark, Soloist Paul Whiteman's Orchestra

You will be astonished at the ease with which you can master a Saxophone. It is the easiest of all wind instruments to play and one of the most beautiful. Three first lessons sent free. You can learn the scale in an hour's practice and play popular music in a few weeks. Practice is a pleasure because you learn so quickly. You can take your place in a band within 90 days if you so desire.

Free Saxophone Book Tells what each Saxophone is best adapted for; when to use singly, in quartettes, sextettes, octettes, or in regular band or Saxophone Band, and how to play from cello parts in orchestra. Send coupon below for free copy.

BUESCHER

True-Tone Saxophone

Unrivalled for home entertainment, church, lodge or school. In big demand for orchestra dance music.

Buescher popularity and superiority is proven by the fact that Buescher makes more Saxophones than all other manufacturers combined.

(48)

The Choice of Professionals

True-Tone Musical Instruments have helped make famous Tom Brown, Art Hickman, Clyde Doerr, Donald Clark, Clay Smith, Guy Holmes, Paul Whiteman, Meyer Davis, Joseph C. Smith, Ben Selvin, Ben Kreuger, Henry Santley, Vincent Lopez and thousands of others. $500 to $1,000 weekly for but two hours a day is not uncommon for musicians of such ability to earn. You may have equal talent and enjoy the most pleasant of vocations.

Buescher-Grand Cornet

The Buescher Grand Cornet is exceptionally easy to blow, yet possesses a tone of wonderful volume. If you expect to learn to play a cornet, you should by all means have a good instrument. With a Buescher-Grand, you own an instrument similar to that with which the greatest cornetists of America have made their reputations.

Free Trial—Easy Payments

You may order any Buescher Saxophone, Cornet, Trumpet, Trombone, or other Band or Orchestral Instrument without paying in advance, and try it six days in your own home, without obligation. If perfectly satisfied, pay for it on easy payments to suit your convenience. Mention the instrument interested in and a complete catalog will be mailed free. Send the coupon for a free copy of the most interesting booklet on the Saxophone ever published.

Buescher Band Instrument Co.
Makers of Everything in Band and Orchestra Instruments
3148 Buescher Block Elkhart, Indiana

Buescher Band Instrument Co.,
3148 Buescher Blk., Elkhart, Ind.
Please send me a free copy of "The Origin of the Saxophone."

Name .....
Town ..... State .....
Street Address .....
Mention any other instrument in which you are interested

Restore YOUR Pep and Power!

Resist the forces that are sapping your vital powers. Banish the weaknesses that make your life a wretched failure. Stop experimenting with dangerous dope and drugs and foolish fads. Shake off Catarrh, Constipation, Dyspepsia, Bad Blood, Rupture, Nervousness, Weaknesses, Bad Habits, and the other results of neglect and abuse (see consultation coupon). Rebuild your Body and Brain and fit yourself for the joys of a healthy, happy, successful life. I want to help you—I can help you.

STRONGFORTISM—The Modern Science of Health Promotion will aid Nature in Restoring your Flagging Powers and Manhood and Fit you for the Joys of Life. I guarantee it—no matter what your condition is, or what caused it.

Mark the subjects on the free consultation coupon on which you want special confidential information and send with 10c to help pay postage, etc., on my free book—"Promotion and Conservation of Health, Strength and Mental Energy." It's a manbuilder and a life-saver. Send for it Right Now.

STRONGFORT The Perfect Man

LIONEL STRONGFORT
Physical and Health Specialist
Dept. 665. Newark, New Jersey

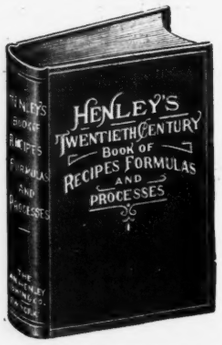
- - - - - *Cut out and Mail this Coupon* - - - - -

FREE CONSULTATION COUPON

MR. LIONEL STRONGFORT, Dept. 665, Newark, N. J.:—
Please send me your book "Promotion and Conservation of Health, Strength and Mental Energy," for postage on which I enclose a 10c piece (one dime). I have marked (X) before the subject in which I am interested.

..Colds	..Increased Height	..Bad Habits
..Catarrh	..Pimples	..Falling Hair
..Asthma	..Blackheads	..Weak Eyes
..Hay Fever	..Insomnia	..Gastritis
..Obesity	..Short Wind	..Heart Weakness
..Headache	..Flat Feet	..Poor Circulation
..Thinness	..Stomach Disorders	..Skin Disorders
..Rupture	..Constipation	..Despondency
..Lumbago	..Biliousness	..Round Shoulders
..Neuritis	..Torpid Liver	..Lung Troubles
..Neuralgia	..Indigestion	..Stoop Shoulders
..Flat Chest	..Nervousness	..Muscular Development
..Deformity (Describe)	..Poor Memory	..Great Strength
..Female Disorders	..Rheumatism	
..Successful Marriage	..Manhood Restored	
	..Weaknesses	

Name .....
Age ..... Occupation .....
Street .....
City ..... State .....



TWENTIETH CENTURY
Book of
Recipes, Formulas and Processes

This book of 800 pages is the most complete Book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for every-day use. Hints, Helps, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

10,000 Practical Formulas—The Best Way to Make Everything

A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work.

Price $4.00

Popular Science Monthly
225 West 39th Street, New York

THE HOME WORKSHOP

This Wheel Travels as Quickly as the Wind

A SIMPLE wind-driven wheel may be constructed from a 5-in. circle of light cardboard. About ¾ in. from the rim draw another circle and divide this smaller

Cutting the flaps

circumference into six equal parts by taking the radius and stepping it off around the circle. Connect these marks with straight lines running through the center and cut

Bending the wings

through the lines with a sharp kitchen or pocket knife. Bend the flaps thus formed outward at right angles to the rim so that they point alternately to the right and left.

This completes the windwheel. To set it going, roll it gently along the ground so

Starting the wheel

that the wind will catch the projecting flaps and push it forward. It is said that such a wheel will role for miles, provided it does not strike an obstruction, and its speed will be little less than the velocity of the wind itself.—E. BADE.

To Prevent an Ax-Handle from Getting Bruised

HANDLES on axes, after much use, will become bruised and splintered on that part which is nearest the cutting iron.

Ax-handle protector

To remedy this it is necessary merely to screw a piece of galvanized iron to the part as shown in the illustration.—H. A. GUSTAFSON.

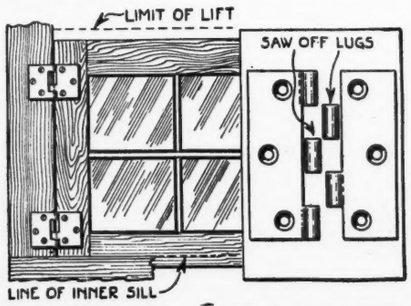
THE HOME WORKSHOP

Try This Liftswing Hinge for Small Windows

WHERE it is impossible or undesirable to install small windows of the sliding, drop, or lift type, as in basements, an ordinary 5-lug steel butt hinge may be adapted to make a window of the swinging type.

The windowsill is constructed as usual, and the outer side stops are also so placed. No stop is needed above on the outer side, for the frame of the window will serve instead, the construction being such that the window may be slid upward a short distance, so that the sash may be swung in over the inner sill.

The hinge is prepared by disassembling, and then sawing off two of the pivot lugs—



Hinge detail and method of attachment

care being taken to remove those that will allow of a lift when the hinge is in position.

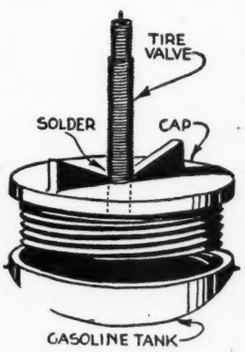
With the hinge in place on the closed window, to open the window, it is necessary merely to lift the sash up from behind the inner sill and swing it inward. To close, reverse the operation.

An ordinary spring-bolt set in the side rail of the sash farthest away from the hinges, and engaging with a socket in the window-frame, serves to hold the sash locked in the closed position.

Supplying Pressure Feed for the Ford Car

IT is sometimes desirable to install some means of pressure from the gasoline tank to the carburetor. This is especially essential where the tank has been lowered in a speedster body, and the owner does not wish to use a vacuum feed. A very simple and economical method of constructing a pressure system is the following:

A ¼-in. hole is bored in the filler cap and directly over it is soldered an automobile tire-valve that has been cut to a convenient length. The soldering must be airtight and the air-vent or hole in the cap should be stopped. When the cap is firmly screwed down, the tank should be practically airtight The pressure may be supplied by an ordinary tire-pump.



Tire valve soldered to cap

A Great Year to Succeed!

A renowned predictor has said; "In 1922 success is due."

Success to those who are MASTERS OF THEIR TIME.

You can only be master of your time when you possess a thoroughly reliable, reputable high grade watch. There is no watch made that excels THE SANTA FE SPECIAL in reputation, reliability or workmanship. He who owns one always knows his time. We expect to put this Great Watch into the pockets of 50,000 men who are on the road to success in 1922. With this as our goal we have made our margin of profit on the sale of a watch so small it defies competition.

Will you be one of the 50,000? If you expect to succeed you must act—ACT NOW! If you want a great watch with a lifetime guarantee, do not delay—order a SANTA FE SPECIAL this minute! You do not have to pay cash—we trust you. ACT NOW!

Always Thrower
Pres., Santa Fe Watch Co., Topeka, Kans.

Senator Capper O.K.'s Santa Fe Special
I am glad to say that your "Santa Fe Special" Watch has given entire satisfaction, and I believe is the very best watch value for the money I have ever seen.
ARTHUR CAPPER,
United States Senator.

The ILLINOIS "Famous" Santa Fe Special 21 JEWEL RAILROAD WATCH $3.50 A MONTH

The Standard Railroad Watch that is GUARANTEED FOR A LIFE-TIME OF SATISFACTORY SERVICE. These watches are now in service on practically every railroad in the United States and in every branch of the Army and Naval Service. Thousands of them are distributed around the world. Your name or monogram and any emblem you may desire will be engraved in the case to suit your own ideas.

Save One-Third to One-Half of Your Money

Save One-Third to One-Half the price you pay for a similar watch made by other manufacturers. Most Liberal Offer Ever Made. Our "Direct-to-You" low wholesale terms and Extra Special Distribution Plan is fully explained in the New Santa Fe Special booklet just off the press. The "Santa Fe Special" Plan means a big saving of money to you and you get the best watch value on the market today.

Send Your Name Today

A letter, post card or this coupon will bring my beautiful Watch Book FREE

Clip the coupon, fill out and receive the beautiful FREE 52-page, 4-color art watch book. All the newest watch case designs are shown. Read our easy payment offer. READ the so-called secrets of watchmaking and the jewelers' trade—tells how we can sell Railroad watches at practically half the price charged by retail jewelers. READ our great "Direct-to-You" offer. DON'T BUY A WATCH UNTIL YOU HAVE SEEN THE "SANTA FE SPECIAL."

Watch sent for you to see without one penny down.

SANTA FE WATCH COMPANY
180 Thomas Bldg., TOPEKA, KANS.

Santa Fe Watch Company
180 Thomas Bldg., Topeka, Kans.

Please send me your New Watch Book with the understanding that this request does not obligate me in any way.

Name .....
Address .....
State .....

MAKE MONEY AT HOME

YOU can earn from $1 to $2 an hour in your spare time writing show cards. Quickly and easily learned by our new simple method. No canvassing or soliciting. We teach you how and guarantee you steady work at home and pay you cash each week. Full particulars and booklet free.

AMERICAN SHOW CARD SCHOOL
206 Ryrie Building Toronto, Canada

DIAMONDS · WATCHES · CASH OR CREDIT

Prices Greatly Reduced

Write for Free Wonderful Bargain Catalog today. Credit terms fully explained. Amazing money saving prices on Diamonds, Watches and Jewelry. $75 Diamond Rings reduced to $50. $100 Rings reduced to $66.75. Proportionate reductions on all other Diamond Rings from $150 up—you save one-third. Cash or Credit. Satisfaction guaranteed. LIBERTY BONDS ACCEPTED.

LOFTIS BROS & CO., National Jewelers
Dept. K-871 108 N. State St., Chicago, Ill.

HAND FORGED RAZOR STEEL BLADES
Indestructible Handles, Liberty Silver Bolsters, Brass Lined, Razor Steel Blades, File Test. Warranted. EASY TO BUY. EASY TO SEND. A JOY TO RECEIVE

FOR HIS BIRTHDAY GIFT

Buy him a beautiful PHOTO HANDLED knife with his name and address on one side, and the COMPLIMENTS OF THE SEASON on the opposite side.

DIRECT TO YOU AT FACTORY PRICES

This $2.25 knife (3 blades) mailed
Postpaid for..$1.50, 3 for $3.75
2 blades for..$1.35, 3 for $3.50

SOUTH BEND CUTLERY COMPANY
Dept. 24, South Bend, Ind.

Build an Aladdin Home and Save $200 to $800

ALADDIN success is chiefly due to the money saved for Aladdin Home owners. You will save a substantial amount thru eliminating dealer's profits, saving over 18% waste in lumber, and lowering labor costs in building. Aladdin Homes are cut to fit, saving waste of lumber and hundreds of hours of carpenter labor. Over a hundred beautiful homes are pictured in the Aladdin catalog. Send stamps for this catalog No. 1705, at once.

Sold Direct—No In-Between Profits

The Aladdin Company is the greatest home building institution in the world and it does not sell through dealers. It manufactures the lumber at the edge of the four greatest timber-producing states. It prepares the house complete ready to be shipped direct to the home builder. You save the dealer's profits. Your carpenter nails the readi-cut lumber just like in any other first-class, permanent home. The catalog explains the details fully.

What You Get When You Buy An Aladdin

Aladdin Homes are designed to use standard lengths and sizes of lumber so that there is practically no sawing, measuring and fitting to be done by the carpenter on the job. You receive in one shipment all the timbered frame work, millwork, the siding, outside finish, porch, shingles, windows, doors, interior woodwork, lath, glass, nails, hardware, lock sets, paints, stains and varnish. Send stamps today for catalog No. 1705.

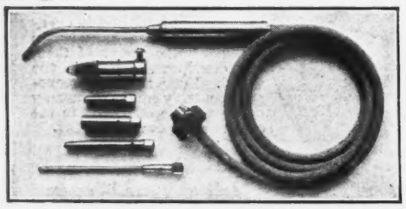
THE ALADDIN CO. BAY CITY, MICHIGAN

Branches; Offices and Mills: Portland, Oregon; Wilmington, North Carolina; Hattiesburg, Miss.

Canadian Offices and Mills:
Toronto, Vancouver, Winnipeg, St. John

ADD $5.00 A DAY TO YOUR PROFITS
By Quicker, Cheaper and Better Work

The TORIT No. 13 ACETYLENE TORCH does the biz. The latest invention for the speedy repairing of radiators, for heating, tempering, sweating, all kinds of soldering, light brazing, etc.



The HANDY outfit for the garage, electrician, and general repair shop QUICK, CHEAP, DEPENDABLE, and will return to the purchaser in a short while, many times its cost. Furnished complete with 4 tips, SOLDERING COPPER, tubing and connection for Presto Auto Tank, Price $7.50. Order one TODAY.

St. Paul Welding & Mfg., Co. 164 W. 3rd St., St. Paul, Minn.

Flowered Tapestry Upholstering. Cane-Panel Ends.

William and Mary Style Davenport Sofa-Bed Only 20c. a Day

Here's a handsome, roomy Sofa for day time use of beautiful design. And for night it becomes in a moment a real comfy, sleep inducing bed. This and nearly 1300 other Furnishings, all shown and described in our big 128 page FREE Larkin Book of Better Homes. Check first line below for Book.

- ☐ Furnishings
- ☐ Symphonic Pianos
- ☐ Symphonic Player Pianos
- ☐ Symphonolas

(Check offer interested in)

Music lovers are found in nearly every community praising our Symphonic Pianos, Player Pianos and Symphonolas (those wonderful phonographs with natural tone which play all Records).

No Money Down—30 Days FREE Trial 1 to 4 Years TIME

Check above for the Book wanted. Send this ad, with full name and address right now.

Larkin Co Inc.
Desk FPSM-222 BUFFALO, N. Y.

OH BOYS-GIRLS GREAT SPORT

THROW YOUR VOICE

Into a Barrel, under the Table, Back of a Door, into a TRUNK, DESK in SCHOOL, Any Old Place. Great FUN fooling the TEACHER, Friends, EVERYBODY with Our

CLAXOPHONE

Which Sets On your Tongue Unseen, it NEVER FAILS Anybody Imt. Birds etc. The CLAXOPHONE, with Full Instructions, a Set Of SECRET-WRITING TRICK, (beats Invs., Ink) a MAGIC-DIAL Trick, (a Great Money maker) ALSO, This Marvelous Novelty-

NEW SCIENTIFIC WONDER "X-RAY" CURIO

With IT you Apparently See thru Clothes, See the bones in your Fingers, Lead in Pencil, etc. No end of fun

3 FOR 25c. BIG FUN

WE SEND ALL ABOVE Novelties by pre-paid Mail for 10c. 3 For 25 cts. A nice Souvenir Free with each 25 ct. order.

CLAXO TRICK CO. DEP. I-K NEW HAVEN, CT.
WE GIVE The BEST and MOST for The MONEY.

PICK your crew, pack your kit, step into an "Old Town" and glide away. Fish the smallest brooks—an "Old Town" will float loaded in the shallowest water. It takes the swiftest rips like a gull. It rides the breakers of a lake with ease. It lasts for years.

For true Indian ideas are reproduced in all "Old Town" models. Indian speedlines, combined with "Old Town" craftsmanship, make them the lightest, fastest, steadiest, most rugged canoes built—and the lowest priced. $54 up from dealers or factory.

New catalog shows leading models in full color. Send for it *now*. Free.

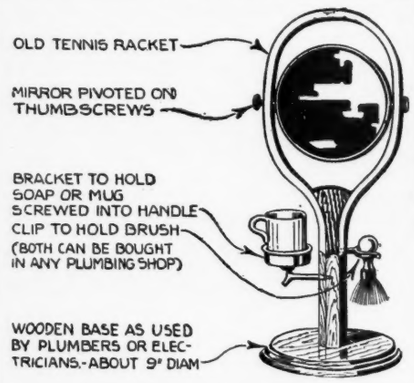
OLD TOWN CANOE CO., 1292 Main Street
Old Town Maine, U. S. A.

"Old Town Canoes"

THE HOME WORKSHOP

Tennis-Racket Transformed into Shaving-Stand

IF you have an old tennis-racket knocking about the attic, you can make it over into a shaving-stand. The handle should be fitted into a wooden base and firmly glued. A round mirror of the correct size to fit inside the frame of the racket should be


OLD TENNIS RACKET
MIRROR PIVOTED ON THUMBSCREWS
BRACKET TO HOLD SOAP OR MUG SCREWED INTO HANDLE
CLIP TO HOLD BRUSH (BOTH CAN BE BOUGHT IN ANY PLUMBING SHOP)
WOODEN BASE AS USED BY PLUMBERS OR ELECTRICIANS.-ABOUT 9" DIAM

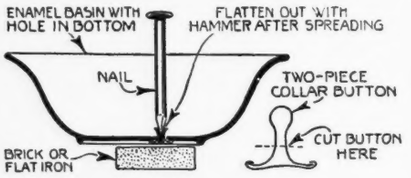
Construction of the shaving-stand

pivoted in place between two thumbscrews.

The addition of a bracket to hold the shaving-mug or soap and a clip for the brush will complete the stand. It may be enameled white or cream, or stained and varnished to match the woodwork or furniture of the room in which it is used.

Repair Leaking Utensils with Collar-Buttons

EVEN an old bent collar-button is worth saving. To repair a leaking utensil with collar-buttons, proceed as follows: Cut off the head of the button and insert the button through the hole in the pan to be repaired. Place the utensil on a brick or solid piece of iron as shown in the sketch and place the point of an eightpenny nail in the open shank of the button. A few light taps with



This repair will bear severe tests

a hammer will then spread and turn over the projecting shank. Then, with the flat of the hammer, flatten the spread button shank.

To prove the practicability of this repair job, a basin repaired by this method was placed on a gas-stove and allowed to remain there until the bottom of the basin attained a red heat. It was then thrown into a tub of cold water. Nearly all of the enamel was cracked off, but the little collar-button rivet still maintained its tightness.

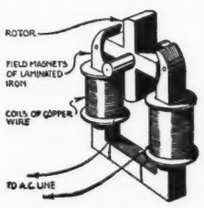
Electrical Prize Awards

WATCH for the announcement of the awards in the "New Uses for Electricity" contest. The winning articles will be published next month in the Home Workshop.

THE HOME WORKSHOP

Making a Synchronous Motor of Simple Design

A SMALL motor that will operate at synchronous speed can be made as shown in the drawing. A rotor having two or four poles is made to revolve between the poles of a laminated horseshoe magnet excited by alternating current.

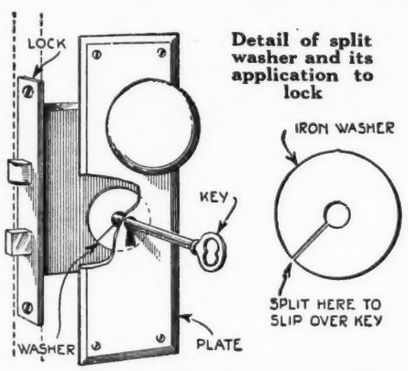


Motor diagram

A motor of this kind is very simple in design, but it must be brought to synchronous speed by hand or other means before it is connected with the line. Although this type of motor can be made in practically any size, the larger machines would of course be very inefficient for power purposes. On the usual 60-cycle alternating current, the motor may be used to operate a clock.

Washer Prevents Removal of Key from Lock

TO prevent the children playing with door-keys and losing them, I adopted a simple way of fastening the keys in the locks. I removed the escutcheon and,

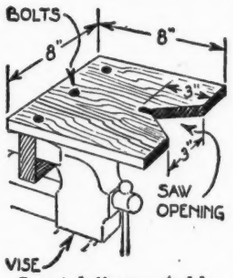


Detail of split washer and its application to lock

after passing the key through the keyhole, slipped over it a ¼-in. wrought-iron washer that had been split open at one place to permit it to go on the key in this way. When the escutcheon was replaced, the washer prevented the key from being withdrawn.—JOHN H. STEIN.

Support for Jigsaw Work

WHEN using the jig- or scroll-saw, some solid support is necessary. A piece of hard wood about 1 in. in thickness is used for the table. It should be about 8 in. square. Saw this piece into the shape shown, which provides a slotted opening for the working of the saw. Take a piece of wood 1 in. thick and 2 in. wide and the same length of the table board and bolt to the end of the table or top piece as shown, using countersunk bolts. Fasten the table in a vise when using the saw.—B. F. DASHIELL.



Special jigsaw table

C. G. CONN Ltd.
TRADE MARK REGISTERED

Stars Endorse Conn Saxophones

1—**Joseph Smith,** Victor records: "Conn tone appeals."
2—**Paul Biese,** Columbia records: "Excels my expectations."
3—**Isham Jones,** Brunswick records: "Most remarkable instrument."
4—**H. Benne Henton,** Victor records: "No other approaches Conn."
5—**Ted Lewis,** Columbia records: "Most perfect saxophone made."
6—**Mathew Amaturo,** Benson's Orchestra: "All one could wish."
7—**Al Starita,** Grey Gull records: "Unquestionably the best."
8—**Al Knecht,** Sousa Soloist: "Best I ever used."
9—**F. Molineu,** Garde Republic, Paris: "Superior to all."
10—**Jean Moermans,** Gilmore and Sousa: "None can equal Conn."
11—**Ruth Glanville,** feminine virtuoso: "Truly wonderful."
12—**H. Virgil Moore,** instructor: "I owe part of my success to Conn."
13—**Howard Grantham,** vaudeville: "Conn is my choice."
14—**H. H. MacLean,** soloist: "Worthy highest praise."
15—**J. W. Holcomb,** soloist: "Gives me inspiration."
16—**H. W. Keller,** Marigold Gardens: "In a class by itself."
17—**Law Reynolds,** soloist: "Improvements valuable to performer."
18—**John Becker,** Sousa Soloist: "Surprisingly perfect."
19—**Billy Markwith,** Brown's Sextet: "Our absolute preference."

Trumpeters

20—**Georges Mager,** Boston Symphony.
21—**Henry LaBarbier,** Minneapolis Symphony.
22—**P. Cappodiferro,** New York Symphony.
23—**Fred Weiss,** Cincinnati Symphony.
24—**William Thieck,** Minneapolis Symphony.
25—**Harry Glantz,** Philharmonic, New York.
26—**Barnard Baker,** Victor Concert Orchestra.

INSTRUMENTS *Built For Quick Mastery*

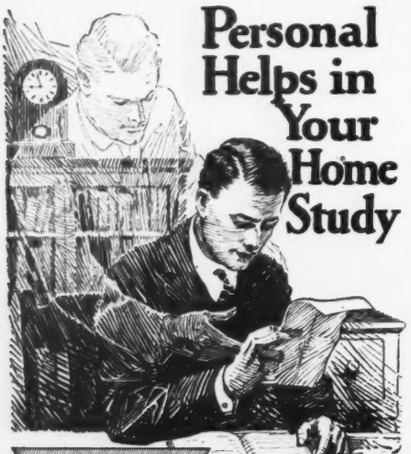
BECAUSE its tapering tube is expanded to perfect proportions by hydraulic pressure, which gives a smooth-as-glass interior, the Conn Saxophone is *easier to play, yields finer tone.* Sockets drawn from tubing prevent leaks; rolled edges preserve pads, which are made over metal rings, sustaining shape. Patent device enables tuning to finest degree. Such improvements have made Conn—the first American maker—now the largest producer of saxophones in the world.

Conn trumpets are used in the great symphonies for the brilliant beauty of their true trumpet tone. Three models; *Opera Grand,* small bore; *Symphony,* medium bore; *Concert Grand,* large bore — a trumpet for every purpose.

Cultivate your musical "bump" for profit and pleasure. Start now by sending the coupon below.

C. G. CONN, LTD. 232 Conn Bldg, Elkhart, Ind.
New York Conn Co. 233-5-7 W. 47th Street

C. G. CONN, LTD. 232 Conn Bldg., Elkhart, Ind.
Gentlemen: Please send me, free, a copy of "Success in Music and How to Win It" by John Philip Sousa, and details of your Free Trial, Easy Payment Plan. (Mention Instrument.)
Name _____
Street or Rural Route _____
City, State, County _____
Instrument _____



Personal Helps in Your Home Study

A student in a Middle Western State writes:

"I am enthusiastic about your accounting course. It is the best arranged and most practical I have seen. The service you give in correcting papers and the personal attention and individual interest shown are as fine as any organization can offer."

This is only one of hundreds of letters of appreciation of the unique instruction methods of the United Y. M. C. A. Schools, which are the development of 25 years of successful experience in training men by the individual method.

Nothing is more important in correspondence instruction than the help of a friendly, competent instructor who deals with you as a real person, writing to you frequently in aiding you to solve your problems.

This kind of service is available to you, no matter where you live, or how special your needs may be, and at a surprisingly moderate cost.

There are five other good reasons why you should enroll in the United Y. M. C. A. Schools for your home-study course and learn how to get "the most service for the least money."

Mark and mail the coupon for these reasons and other interesting details. Our counsel is free.

United Y. M. C. A. Schools

Dept. 8-F, 375 Lexington Ave., New York City

I am interested in United Y. M. C. A. Schools' service. Please give me free counsel as to the position or home-study course I have marked.

—Accountant	—Farm Motor Mechanics
—Advertising Man	—Foreign Languages
—Agricultural Courses	—Foremanship
—Applied Psychology	—Freehand Drawing
—Architect	—Highway Engineering
—Auto Mechanic	—Illustrator
—Banking	—Locomotive Operator
—Better Letters	—Machine-Shop Practice
—Bookkeeper	—Mathematical Courses
—Building Construction	—Mechanical Engineer
—Business English	—Plumber
—Business Law	—Poultry Husbandry
—Business Organization	—Radio Operator
—Chemistry	—Radio Engineer
—Civil Engineer	—Railroad Engineering
—Civil Service	—Salesman
—Commercial Spanish	—Secretarial
—Concrete Engineer	—Steam Engineer
—Dairy Farming	—Stenographer
—Draftsman	—Structural Drafting
—Electrician	—Surveyor
—Electrical Engineer	—Tool Designing
—English Courses	—Traffic Management
—Factory Management	—Use of the Slide Rule
—Farm Management	

Name and Occupation .....
(Please Write Plainly)

Complete Address.....

MAKE MONEY Building Phonographs

We furnish everything — blue print plans—case material, tone arms, motors, full instructions. You can easily make $100 to $200 a month in spare time. Even boys of 14 make them. They play any record. Wonderful tone—equal to any you ever heard. Sell to friends and neighbors. Write now for free blue print offer.

It's easy with our plans.

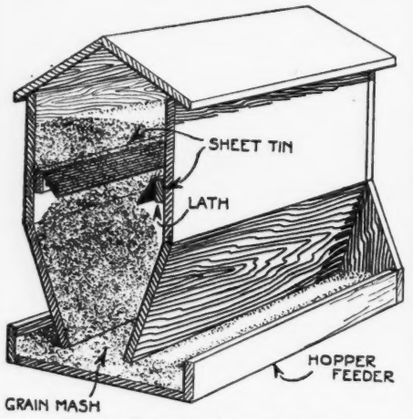
Choraleon Phonograph Co.
221 2d St., Elkhart, Ind.

THE HOME WORKSHOP

To Prevent the Poultry-Feeder Becoming Clogged

GROUND dry mash clogs the poultry-feeders more or less but tin "lips" fastened to the inside will insure "feeding down." They are easily, quickly and inexpensively attached. The required materials consist of several pieces of tin, at least 3 in. wide—enough to extend along each side of the feeder, laths and nails.

Fasten the tin to the inside of the feeder, about 3 in. from the bend, with a lath,



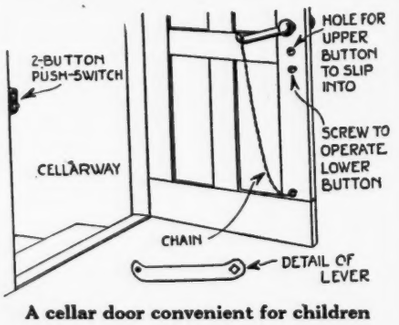
Method of attaching tin lips

allowing 2½ in. width of tin to be bent over the lath at about an angle of 45 degrees to form the lip. Do not fasten them at the ends of the feeder.

The performance of these lips is obvious—they "break" the weight of the mash and prevent its packing.

Closing Door Turns Out Light

MY children had a habit of leaving the electric light turned on in the cellar whenever they went down there. They could turn the "juice" on all right, but they never remembered to push the switch when they left. Furthermore, the smaller ones, when they came up from the cellar, could not reach the handle of the door if it



A cellar door convenient for children

happened to be shut and had to knock until one of their parents came to their rescue.

To obviate these two difficulties, which interfered many times with the peaceful reading of my evening paper, I arranged the device shown in the drawing. The cellar switch is turned on in the usual way and remains on while the door is open. The closing of the door shuts off the light.

If the door is closed, as frequently happens during the day when the children are in the cellar, they are able to open it themselves by pulling the chain attached to a lever on the stem of the doorknob.—JOHN STEIN.

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first.*

The Natural Body Brace

Overcomes WEAKNESS and ORGANIC AILMENTS of WOMEN AND MEN. Develops erect, graceful figure. Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

For Children Also

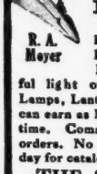
Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation, after effects of Flu. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
241 Rash Building SALINA, KANSAS

Made $164 in one Week



"For just one week my net profits were $164," writes R. A. Moyer. He is only one of hundreds making big money acting as our representative for this wonderful new light.

R. A. Moyer

Burns Kerosene or Gasoline

Gives 300 candle power soft, brilliant light, restful to eyes. Costs 1c an evening. Absolutely safe. Lights with match. Most wonderful light of age—Table Lamps, Hanging Lamps, Lanterns. Big season now on. You can earn as Moyer has. Work all or spare time. Commissions paid same day you take orders. No experience necessary. Write today for catalog and agents FREE outfit offer.

THE DIAMOND LIGHT

THE AKRON LAMP CO.
1602 Lamp Bldg., Akron, Ohio

Thousands Have Succeeded--Why Not You?
"National Success Course"
24 Lessons, Former Price $24.00
Now offered as premium with monthly magazine
"Bookkeeper and Accountant"
TWO YEARS FOR $5.00.
Money back if wanted. Make check to **Charles L. Sweetland, Editor, 452 Pierce Building, St. Louis, Mo.**

DIAMONDS

This Ring $52.50 7/8 – 3/32 Carat Blue White

Here at 60% of Market Price

This blue white perfectly cut diamond 7-8—3-32 ct. at $52.50 among bargains last list. Many other big values in our lists. Buy *HERE.* Loan values the price basis, not market values. This 75 year old *diamond banking firm* has thousands unpaid loans and other bargains must sell NOW.

Why Pay Full Prices

Any diamond sent for absolutely free examination at our risk. No obligation. No cost to you.

Send for Latest List

Diamond Bargains described in detail. *Tells of guaranteed loan values,* unlimited exchange privilege, details of free examination. *Send now.*

JOS. DeROY & SONS 4783 DeRoy Bldg. Only Opposite Post Office, Pittsburgh, Pa.

10 Cents a Day Pays

For smaller Symphonola. Style pictured and others 7c to 25c a day. Tens of thousands giving satisfaction.

Symphonolas

No expensive attachments needed to play all Records. Tone natural, life like. Well built. Highest quality equipment.

No Money Down

Shipped anywhere in U. S. 30 days FREE Trial before you make first payment. If pleased take up to 2 years' time.

Records 70c Each

Play on all phonographs using steel needles. Latest vocal and instrumental hits. Also Sacred and Operatic. Full size 10 inch. Postpaid. Ask Today for Symphonola Booklet and Record List.

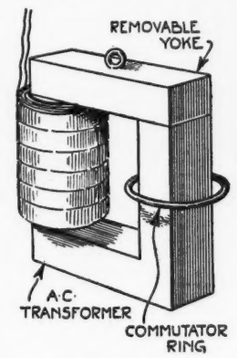
Larkin Co Inc.
Desk S.P.S.M. 222 Buffalo, N.Y.

THE HOME WORKSHOP

Expanding Commutator Rings with Electric Heat

SHRINK-RINGS used in commutator work must be expanded before they are fixed in place. To do this any electrician can make a machine using electrically generated heat.

A small, heavy current transformer is constructed from an old transformer core, which is supplied with a primary winding. The yoke of the core is a separate piece so that it can readily be removed. This permits the placing of the commutator ring over one leg of the transformer, and the ring then acts as a short-circuited secondary. Heavy currents are generated within it and its temperature consequently can be controlled by regulating the current passing through the transformer.

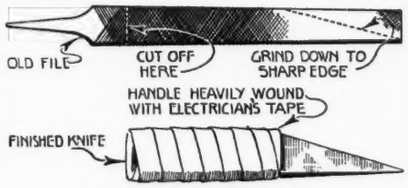


Heating a ring electrically

Making a Knife from an Old File

SMALL files when worn out can be turned into good knives that will be found very handy in the tool-kit of the general mechanic.

The tail end of the file is cut off to the desired length (about 5 or 6 in.), and about



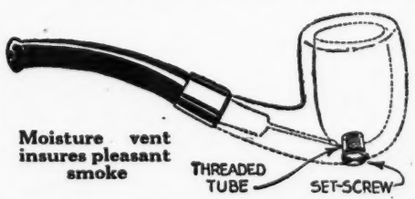
A knife that keeps its edge

1¾ in. on the opposite end is ground to form the blade. The excess material is removed by means of the grindstone and then ground to an edge on the emery-wheel. An oilstone is used to put on a good cutting edge.

As file-steel is highly tempered, the knife will take a fine sharp cutting edge. The handle of the knife should be heavily wrapped with electrician's friction tape.

A Self-Cleaning Pipe

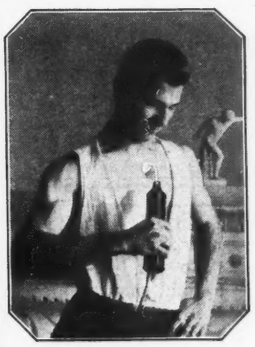
YOU may make your pipe self-cleaning by boring a small hole in the bottom of the bowl and inserting a piece of tubing



threaded on the inside and fitting it with a set-screw.

When the pipe shows signs of moisture, remove the set-screw, and place the palm of your hand tightly over the top of the bowl, blow into the stem, and the moisture will be ejected through the tubing.

Build a New Body



Stimulates, invigorates and strengthens weak bodies

Treat Yourself at Home for—

NERVOUSNESS
NEURALGIA
RHEUMATISM
SCIATICA
HEADACHES
ANAEMIA
INSOMNIA
BRAIN-FAG
NEURITIS
PARALYSIS
LUMBAGO
INFLAMMATIONS

Any nervous disorder or painful Chronic Disease

Drives out aches and pains wherever applied

Rid Yourself of Weakness, Pain and Disease

Just as sunshine purifies the air and strengthens every living thing, Violet Ray treatment will purify your blood, strengthen and stimulate your body, drive out aches and pains and give you the steady nerves and vitality necessary for success. One treatment in your own home will prove this without risk to you. Our free "Health Book" tells how this wonderful treatment increases the number of red corpuscles and the oxygen content of the blood, and how it saturates the body with life-laden, health-building energy.

RenuLife *VIOLET RAY HIGH FREQUENCY*

—possesses the wonderful power of bringing a vigorous surge of rich, fresh blood to any weak, diseased or painful part of the body. Congestion is relieved, poisons are washed away, the part is warmed and soothed and the new blood carries away the diseased cells and replaces them with healthy, new nerve and muscle tissue. It literally builds new bodies. If your body is thin and undeveloped, if you lack nerve force and vitality, if you suffer from insomnia and brain fag and if you want *immediate* relief, you should

Safe for use on infants or elderly patients

Instantly stimulates the circulation of blood

Send for Free "Health" Book

It has pointed the way to health and success for thousands. It has shown them how to acquire "driving power" for their daily work, and calm nerves that permit sound sleep at night. It has enabled them to cure painful chronic diseases such as rheumatism, headaches, neuritis, etc. More than 100 disorders and weaknesses are successfully treated. It is not a "cure-all," but no matter what your trouble is, our Free Book will tell you whether or not you can be benefited.

RENULIFE ELECTRIC COMPANY,
1802 Newbury Bldg., Detroit, Mich.
In Canada: Netting Bldg., Windsor, Ont.

WANTED
Sales agents on very attractive basis. Investigate our exclusive sales contract.

CARPENTRY
By GILBERT TOWNSEND, S.B.
A practical treatise for the use of carpenters and woodworkers on simple building construction, including framing, roof construction, general carpentry work, and exterior and interior finish of buildings. 258 pp., 368 ills. Price, $2.10.
Popular Science Monthly, 225 West 39th Street, New York

Practical Use of the Steel Square
Vol. I and II. By F. T. Hodgson
The methods of using the Steel Square to make it of the most practical value to the carpenter and workman are fully covered. Illustrated with diagrams and explanatory sketches. 600 pp., 500 illus. Price, 2 vol., $3.00
Popular Science Monthly, 225 West 39th St., New York City

SELL US YOUR SPARE TIME
We will train you to write show cards for us. No canvassing or soliciting; we supply you with steady work; distance no object; will pay you from $15 to $50 a week.
WILSON METHODS, LIMITED
Dept. C 64 East Richmond, Toronto, Canada

MUSIC LESSONS FREE

You can read music like this quickly
IN YOUR HOME. Write today for our FREE booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced players. Your only expense about 2c per day for music and postage used.
AMERICAN SCHOOL of MUSIC, 32 Lakeside Bldg., CHICAGO

BLUE PRINT READING
Our new Special Courses for Machinists, Pattern-makers, Iron-workers, Blacksmiths, and Building Tradesmen, qualify them by mail to read blue prints and become gang foremen. Taught from actual blue prints—Easy to learn—no mathematics—no drawing—prices satisfactory. Pay-as-you-learn Plan. Write for booklet and free sample blue print.
INDUSTRIAL CORRESPONDENCE UNIVERSITY, Inc.
Dept. F258 1504 LOCUST STREET, PHILADELPHIA, Pa.

Mechanical Engineering

Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 30 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 300 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7659-B SCRANTON, PA.

Without cost or obligation, please explain how I can qualify for the position, or in the subject *before* which I have marked an X in the list below:—

☐ ELEC. ENGINEER	☐ BUSINESS MANAG'M'T
☐ Electric Lighting & Rys.	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING
☐ Telegraph Engineer	☐ Railroad Positions
☐ Telephone Work	☐ ILLUSTRATING
☐ MECHANICAL ENGR.	☐ Show Card & Sign Ptg.
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ Private Secretary
☐ Toolmaker	☐ Business Correspondent
☐ Gas Engine Operating	☐ BOOKKEEPER
☐ CIVIL ENGINEER	☐ Stenographer & Typist
☐ Surveying and Mapping	☐ Cert. Pub. Accountant
☐ MINE FOR'N or ENGR.	☐ TRAFFIC MANAGER
☐ STATIONARY ENGR.	☐ Railway Accountant
☐ Marine Engineer	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Com. School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ AUTOMOBILES
☐ Structural Engineer	☐ Railway Mail Clerk
☐ PLUMBING & HEAT'G	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation
☐ Text. Overseer or Supt.	☐ Agriculture
☐ CHEMIST	☐ Poultry ☐ Spanish
☐ Pharmacy	☐ Banking ☐ Teacher

Name _____ 7-1-21

Street and No. _____

City _____ State _____

Occupation _____

Keeping the Home Shipshape

How to do those odd jobs around the house that save time, temper, and money

Weather Strip for Windows

THIS is the time of year when a little attention to window-sash is repaid many times over in comfort to the household and in saving of fuel.

Loosen the sash-lock and shake the upper sash. If it rattles at all in the frame, obtain enough weather strip—perhaps 8 or 9 ft.—to go around outside the upper sash. Nail it with 1-in. brads on what is called the blind-stop across the top and down both sides as far as the lower edge of the meeting rail. When nailing, press the weather strip firmly against the sash, but not so hard that the sash will slide with difficulty.

Fasten the sash-lock and notice if it pulls the meeting rails close together. If not, take out the small screws in either half of the catch, plug the holes in the sash and replace the part so that the catch will draw the meeting rails tightly together when fastened.

The window will now be almost airtight. If it is not, use a wide chisel to pry off the ½ in. by 1½ in. stops, taking care not to deface the finished sides. Either pull the nails through the back or cut them off. Replace the stops by starting to nail at the meeting rail, and be sure the catch is locked. Between the lower sash and the stop leave a space about the thickness of a piece of paper; give more freedom in the upper half so that the sash will slide easily when started. Weather strips should not then be needed for the lower sash.

Snug-Fitting Outer Doors

ARE your outer doors weatherproof? Try them by shaking the handles. If they are loose, unscrew the small plate in the door-jamb technically called the strike-plate, which holds the latch and lockbolt when the door is closed. Plug the small screw holes with wooden plugs, and with a chisel cut out as much as may be needed of the edge of the mortise or recess in which the plate sets to allow it to go in closer toward the door-stop. Do not cut too far or the catch will not enter the plate. It should be so placed that when the door is pushed in gently, the latch will catch.

If the door now fits snugly in the rabbet at both sides and the top, this will be all that is necessary except a piece of wide weather strip on the bottom. That is always a good thing for outside doors in cold weather. It should be put on the side most convenient for opening the door with 1-in. brads or 1-in. No. 6 round-head screws.

Should the door not fit snugly all around, go still further and nail weather strips (of the kind made for doors) on both sides and at the top of the door-jamb on the outside so as to press gently against the door when it is closed and locked. If the door is especially bad, get some wooden door-stop, ½ in. by 1½ in. and nail it around the jamb instead of weather strip, first planing the edge so that it will fit tight against the door. On top of this the regular weather strip may also be nailed, making the door doubly secure.

Removing Wallpaper

SCRAPING old wallpaper from the walls and ceiling of a room is not an easy job. It can be done rapidly by equipping a long section of garden hose with an adjustable sprayer nozzle and attaching the other end to the nearest available faucet.

Remove all articles of furniture from the room that is to be repapered, and spread a number of folded newspapers on the floor. After the furniture has been removed and folded newspapers spread, turn on the faucet lightly, and carefully manipulate the hose so that the fine spray of water strikes the surface of the wallpaper to be scraped off. Be careful to prevent the water from reaching the woodwork, light fixtures, etc. The water will naturally run down to the surbase and floor, but the old newspapers will take up most of the water By applying the water slowly and carefully the old paper on the walls and ceiling is soon water-soaked, and it can then be pulled off with the hands in large-size pieces.—ROBERT F. SALADE.

Replacing Moldings

IF you find it necessary to remove picture-moldings, base, or wood trim of any kind, take great pains in replacing it. Even carpenters are sometimes careless in doing that.

The principal error one is apt to make is to drive the old nails from the back and pull them out from the front, thus either splintering the finished face of the wood, damaging it with the head of the hammer, or both. Nails that have been puttied into place cannot be neatly removed in that way. If they are thin finishing-nails, try to pull them right through the molding from the back with pliers or pincers. If they are by any chance ordinary nails with large heads, simply nick them with a file as near the back surface of the molding as possible and break them off.

AGENTS $1.75
YOU CAN
SELL THIS FOR

AND GIVE THESE SHEARS
FREE

with spring tension device

MY! HOW THEY SELL!

ONLY 20 Boxes a Day Means $18.00 Daily Profit!

You get the interest with the free Shears. Walter Harris Sold 800 boxes in 6 Weeks. Profit over $100.00 a week. A total retail value of $4.60. A real bargain at $1.75.

ACT NOW! Sells like hot cakes year 'round. A baby could sell Lucky 11. Don't delay a minute. Save time.

Send $1.75 for complete outfit including display case. At least write for circulars explaining our unique plans, including 30 other packages. **Act Now.**

E. M. DAVIS CO., DEPT. 1362 CHICAGO, ILL.

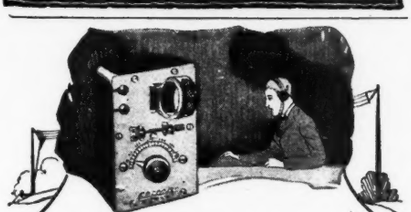
Free Music with the EVERYMAN Radiophone Receiver

Listen to music, speeches, lectures. Get time signals, sport and political news, weather and crop reports, before released by the press, as sent out daily by radio telephone stations. No knowledge of radio or code required. Instruction and entertainment for the whole family.

Everyman Radiophone Receiver

is designed to receive all radio telephone broadcasting stations, as well as commercial and amateur stations. Made of finest materials; walnut finished case; weight 5 lbs. No mast required. Price $25.00. Aerial equipment $6.50 extra. Can be installed in 30 minutes. Satisfaction guaranteed. Send for catalog. Dealers investigate.

DeForest Radio Tel. & Tel. Co., 1395 Sedgwick Ave., New York



A WIRELESS STATION

complete for $21.00

LISTEN in on the world's news by wireless. This Climax Unit picks up both wireless telegraph and telephone. Simple to operate, sure of results. No battery, no license, no experience needed. Send five cents today for your copy of the new bulletin describing the complete line of

CLIMAX
RADIO RECEIVING UNITS

You can put up a working station, and get results in less than an hour. Address:

Wireless Equipment Co., Inc.
Dept. C2, Newark, N. J.

THE HOME WORKSHOP

Making a Novel, Compact, and Cheap Electrolytic Rectifier

CURRENT rectifiers for experimental work, consisting of two strips of metal, a glass container, and a solution of soda and water, are generally regarded as sloppy and inefficient. Recently, however, the requirements of radiotelephony have restored the device to favor.

In the illustration a single unit rectifier is shown. This type can be used with success in charging small high-voltage storage batteries, using a 20-watt lamp in series with the usual 110-volt house-lighting circuit.

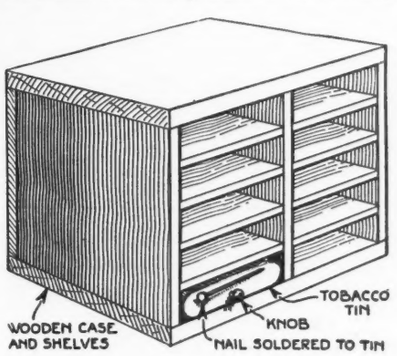
The complete rectifier

The body of the rectifier is made from a small aluminum cup or pan, which can be bought for a few cents. This is fitted with a hard rubber, bakelite, fiber, or some other kind of dielectric top. A fragment of an old battery jar is ideal for the purpose. This top can be bolted or wired to the cup and one electrical connection made at the same point.

The unique center electrode is nothing more nor less than a plated brass paper-clip, which acts as an electrode and a spring binding-post combined and presents ample surface to the solution. A device of greater capacity can be made by increasing the number of aluminum cups and metal clips, mounting them all on a larger piece of rubber. Connect the units in series for high voltage and parallel for heavy currents, or series parallel when both are desired.—R. U. CLARK, 3d.

Old Tobacco Tins Used for a Nail Cabinet

ORDINARY nail boxes are apt to become in time repositories for a miscellaneous assortment of nails, screws, bolts, and what not, much to the annoyance of the home worker when he is in a hurry to find a certain size or kind of fastening.



A handy case for nails and screws

To avoid this, a cabinet may be made holding ten or twelve discarded tobacco tins. On the top of each can a nail or screw is soldered to act as a label of the contents, and a knob is fastened underneath it to serve as a handle.

A cabinet of this description may also be used for kitchen or office supplies.

Listen To Me!

ELECTRICAL EXPERTS

EARN $70 to $200 a Week

Electrical experts are in great demand in all parts of the world. This is the great Electrical age and Electric power is moving the world. I can train any ambitious man to become a Certified Electrical Expert in a short time and able to fill one of these big paying positions.

I WILL TRAIN YOU AT HOME

I am Chief Engineer of the great Chicago Engineering Works and know just the kind of practical up-to-date training you need to hold the best Electrical positions. I can train you at home by my wonderful lessons and Electrical apparatus which I send you.

SUCCESS GUARANTEED

I have trained hundreds of Electrical Experts and can do the same for you. So sure am I of this that I guarantee under bond to return every cent if you do not succeed. No school will do this.

FREE *Big Electrical Outfit*

A fine set of Electrical supplies, instruments and tools for practical work—absolutely free—while they last I am giving every student one of these great outfits. Write now—today.

Write! Send today for proof lessons and wonderful Electrical Book—BOTH FREE—send coupon or postal.

CHIEF ENGINEER COOKE,
Chicago Engineering Works, Dept. 32A,
2150 Lawrence Ave. Chicago, Illinois

FREE OUTFIT COUPON

CHIEF ENGINEER COOKE, Chicago Engineering Works, Dept. 32A, 2150 Lawrence Ave., Chicago, Ill.

Please send me **ABSOLUTELY FREE** your book, "How to Become an Expert Electrician," and your Special Electrical Proposition.

Name.....

Address.....

City..... State.....

BE A RAILWAY TRAFFIC INSPECTOR

POSITION GUARANTEED

Earn Up to $250.00 per Month
Expenses Paid

MANY fine opportunities for trained Railway Traffic Inspectors. Steady, pleasant outdoor work: travel or remain near home.

Easy to Qualify

Prepare in three months' *spare-time* study at home. Position then *guaranteed* at not less than $110 per month and expenses, with many chances for advancement thru contact with big railway officials.

"My Salary Was Raised"

Read what Mr. James M. Hurt, Jr., says about the work:

"After finishing your course in Traffic Inspection about three months ago, I was placed in a permanent position at $110.00 per month. Several days ago my salary was raised to $135.00 per month, and I have every reason to believe it will go higher soon if my work is satisfactory.

"Have come to the conclusion that there are very few classes of work in which the opportunities are as unlimited and at the same time, the work as pleasant as Traffic Inspection."

You Take No Risk

If position is not obtained for you, entire enrollment fee is refunded without question. You have nothing to lose.

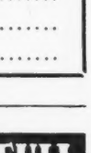
Send coupon for details and booklet No. D-587.

Standard Business Training Inst.
Buffalo, N. Y.

Date.....
Standard Business Training Inst.
Buffalo, N. Y.
Gentlemen:
Send me by return mail, entirely free, full details about profession of Railway Traffic Inspection and booklet No. D-587.

Name .....
Street .....
Town & State .....

$1.00 CASH PAYS IN FULL NEW STUMP PULLER



This new Stump Puller costs you only $1 cash. You build it *alone* easily. Pulls biggest stumps. Complete plans, blue prints, etc., for $1.00. Send today to **Home Made Stump Puller, 3351 First St., Gladstone, Mich.** Adv. Y

Delivered to you Free

for 30 days trial on approval. Your choice of **44 Styles**, colors and sizes of famous **Ranger** Bicycles. **Factory-to-Rider** lets you buy at wholesale prices, *express* prepaid, direct from maker.

12 Months to Pay lets you enjoy your **Ranger** at once. Many boys and girls easily save the small monthly payments. The **Ranger** is a better bicycle than you can buy anywhere at any price.

Tires lamps, horns, wheels, parts and equipment at half usual prices.

SEND NO MONEY. Simply write for our big, Illustrated free **Ranger** catalog with lowest prices and terms; also Special Rider Agent offer.

Mead Cycle Company Dept. S109 Chicago

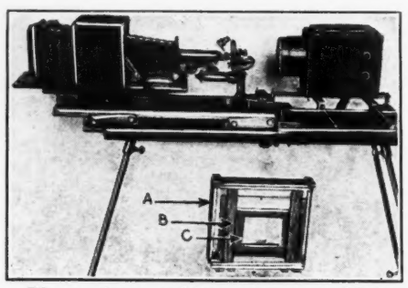
THE HOME WORKSHOP

Photomicrographic and Enlarging Camera

By Clement B. Davis

FINDING myself in need of a photomicrographic camera and an enlarging outfit, I combined part of an old motion-picture projector and a 4 by 5 in. long-focus camera as seen in the illustration.

The lamp-house, condensing-lens, and stand were used practically as they were. To raise the microscope into alinement with the condenser, an adjustable elevating device was made. Two boards were connected by four short strips, two on each side, something like a parallel ruler. The upper board thus remains constantly parallel to the lower one and can be held firmly at any height by tightening the nuts on the bolts that run through the boards. To bring the camera to the proper height for the microscope, it was supported on a low shelf, the legs of which are screws. This permits ready adjustment for centering and making allowance for any slight warping. This shelf is then firmly fastened with a long screw to the board upon which it is placed.



Photomicrographic camera assembled

The illustration shows the apparatus set for photomicrographic work. For enlarging, the microscope is removed and the regular lens, an ordinary 5 by 7 in. rectilinear, is put in place. The negative to be enlarged is carried by an adjustable negative holder, which fits on the guides of the lamp-house close to the condenser.

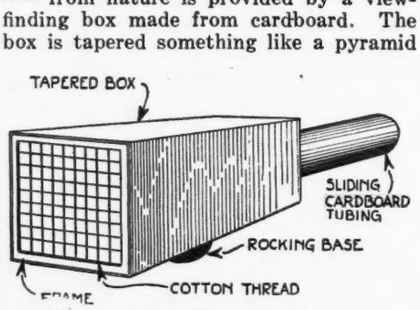
This negative holder, shown below, consists of an outer fixed frame *A*, carrying a horizontally sliding frame *B*, which in turn carries a vertically sliding frame *C*, in which the negative to be enlarged is held. The frame *C* is held in place by short bolts that slide in vertical slots in frame *B*, and are fastened by wing-nuts. This device allows any part of the negative to be centered. The elevating device to which the camera is fastened by an ordinary tripod screw, slides along side guides, which preserve the alinement.

The sensitive paper is carried on an easel or on the wall of the room, and the apparatus is placed at a proper distance for the desired enlargement. If there is much vibration, the paper should be carried on an extension from the apparatus itself and the whole suspended by rubber cords or springs, as in the case of the cameras used in photo-engraving houses.

When not in use, this apparatus readily comes apart and may be stored in small compass.

View-Finder Furnishes Aid for Nature Sketching

AN amusingly easy method of drawing from nature is provided by a view-finding box made from cardboard. The box is tapered something like a pyramid with a blunt top, 8 in. square at one end, 5 or 6 in. at the other, and about 18 in. long.



The squares make perspective easy

Over the narrow end is glued a square of cardboard with a round hole to permit the insertion of a 9-in. length of cardboard tubing arranged to slide in and out. The wider end of the box is fitted with a cardboard or wooden frame across which are stretched lines of black thread at 1-in. intervals, making a checkerboard arrangement of squares. The box is mounted on a rocking base made from half a large spool to permit easy focusing.

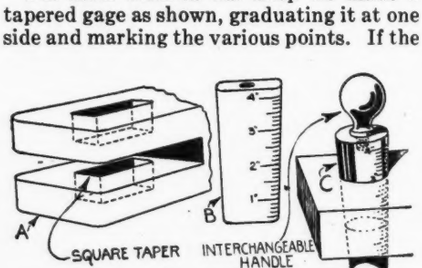
Point the tube in the direction of the object to be drawn, move the tube in and out and rock the box until the desired field of view is obtained. Then prop the box firmly in place and copy the view as seen through the frame on a sheet of paper that has been previously divided with light pencil lines into the same number of squares. It is not necessary that the squares on the paper be the same size as those in the frame. Work into each square on the paper the part of the landscape or object that fills the corresponding square in the frame.

The result may not be a work of art, but it will be correct in proportion and perspective.—S. LEONARD BASTIN.

How a Tapered Hole may be Gaged

A TAPERED hole, like the tapered key seat shown, is without question the hardest style of hole to gage.

For such work in our shop we made a tapered gage as shown, graduating it at one side and marking the various points. If the hole is too big, the gage goes down too far, while if the hole is not large enough, the marks on the gage show how much has to come out of the hole. The same idea holds good for round tapered holes, a gage of this nature being also shown. We inserted a handle at the top of each gage, this handle being removable.—J. H. MOORE.

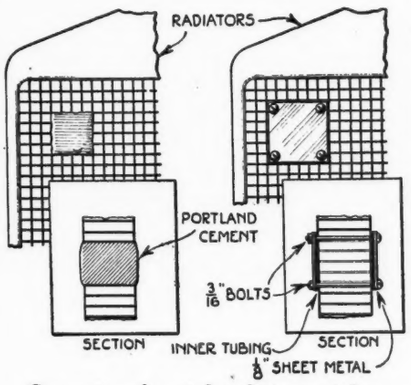


Useful gages for tapered holes

THE HOME WORKSHOP

Two Emergency Repairs for Honeycomb Radiators

TWO emergency repair methods that have proved simple and satisfactory are illustrated. The first method illustrated consists of a hydraulic cement repair on a honeycomb type of radiator that had been removed on two occasions for repair to a small section that had been jammed. Each time this was soldered, the



Cement and metal radiator patches

heat seemingly loosened the adjacent solder.

Using a mixture of cement and water, the cells were filled entirely across the radiator without the removal of the part, though the water was drained. After permitting this to set twenty-four hours, the radiator was filled and failed to leak, contrary to expectations. The repair has lasted six months without leakage.

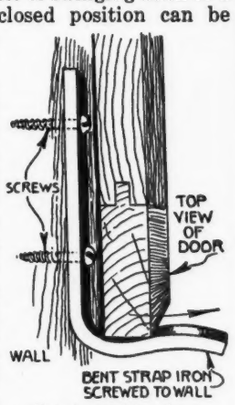
The second method illustrated is a positive repair, though more conspicuous than the first.

It consists of a rectangular patch of ⅛-in. sheet metal on each side of the radiator, clamping two sections of rubber cut from inner tubes and held with four small 3/16-in. screwbolts.

The edges of the clamp must necessarily cover the entire defective region of the cellular openings.—G. A. LUERS.

This Door-Catch Is Useful for Outbuildings

ANY outbuilding door that has an exasperating habit of swinging back to a closed or nearly closed position can be cured of its fault by means of a very simple device. A piece of light and springy steel is bent to the shape shown and secured to the wall at such a point that when the door is flung back it will pass over and engage the "hump" of the catch, which will hold it. A slight pull will release the door when it is desired to close it.



Catch holds door open

The beauty of this fixture lies in its cheapness and simplicity. It can be made in a few minutes and applied in any place where appearances are not the important consideration.—LOUIS SCHNEIDER.

Plug Your Home in On the Radio Line

If you can listen over a telephone, you can listen by wireless. It's just a matter of turning a small knob. And the air is full of music and entertainment. You can hear your favorite artists, Bert Williams, Al Jolson, Hofman, Heifetz, or Farrar. Then there is the important news of the world and special speeches by well-known men. The program is continuous from morning until night, ending with wireless bedtime stories for the children. The radio age is surely here. Be modern, install a small, inexpensive outfit and bring this entertainment and education into your home. You don't realize how much fun can be had by a radio evening at home. A real surprise for the guests too.

As Easy as Playing a Phonograph!

No high wires, batteries and connections to fuss with. You just set the "radio box" on the table and listen. If you can operate a phonograph you can use a radio receiver. The first cost is the last cost. No renewals and no delicate parts to get out of order. Don't miss another day of this great sport. Radio is the master hobby.

The Wonder Receiver From Radio Headquarters

Be sure you secure the right kind of a receiving instrument, Get one designed by the famous experts of the National Radio Institute, Radio Headquarters. Our "Wonder Receiver" shown is only $20.00 and it will bring the voice of the world to your living room table. Beautifully finished in hard rubber with nickled parts and a *leather-covered "non-hair-pulling" head 'phone* To use it you simply string a small piece of copper wire in the attic, *not on the roof.* We supply everything complete,

Six Wireless Books Free!

For thirty days we will give absolutely free with every receiver, six books covering the story of wireless in an interesting, educational manner. All of the wonders of radio are explained in everyday language. We will also send you "NATIONAL RADIO NEWS," the well-known magazine, for six months and give you a membership and lapel pin for the Radio Relay League, the nation-wide association of enthusiasts. All of these features and the best receiver on the market for only $20.00 *But you must act now.*

Literature on request

NATIONAL RADIO INSTITUTE

Radio Headquarters:
1345 Pennsylvania Ave., N. W., Washington, D. C.

MACHINE SHOP WORK

A guide to the most improved methods of modern shop practice, including the construction and use of improved tools and machines, the use of various hand tools, the lathe and lathe tools, and the methods of screw cutting, taper and eccentric turning, etc.

360 pp. 401 illus. Price, postpaid, $2.60

Popular Science Monthly, 225 W. 39th Street, New York

Wrestling Book FREE

Learn to be an expert wrestler. Know scientific wrestling, self-defense, and jui-jitsu. Develop a splendid physique, and have perfect health. Join this popular school and learn by mail. The famous world's champions—the marvelous

Frank Gotch and Farmer Burns

offer you a wonderful opportunity. Wrestling is easily and quickly learned at home by mail. Men and boys write now for splendid free book. Learn all the science and tricks. Be able to handle big men with ease. Accept this wonderful offer NOW. Send for free book today, stating your age.

Farmer Burns School of Wrestling, 1782½ Ramge Bldg., Omaha, Neb.

Hear the Wireless Concerts at Home

from far and near. The latest news, market and weather reports now broadcasted by radio by our Government. Stations all about you

275 page No. 16 Radio Catalog—just out. Send 12c in stamps or coin for your copy of this wonderful catalog. Not sent otherwise.

You could spend $3.00 for text books and other catalogs and then not have the contents of this catalog.

Ever since the year 1909

Duck's Radio Catalog

has blazed the way with everything worth-while and dependable in radio. This catalog eclipses all previous editions, It is all other catalogs in one, No other is even half as large. The complete catalog of the Radio Corporation, with a wealth of scientific data and diagrams, showing how to build powerful radio telephone transmitters, the Remler, Murdock, and in fact all other catalogs, are in this catalog. Over 50 pages of diagrams and data on radio.

Radio Sets Cost Very Little

Complete sets sell for as little as $20—some even less. Today there are thousands bringing into their homes music, concerts and news hundreds of miles away, and with a loud speaker to replace the receivers on the ears, the entire family may clearly and distinctly enjoy the entertainment.

Type "Q" Receiver

The last word in flexibility of reception. Telephone and telegraph stations of all sizes and wave lengths within your reach. With the use of the various sizes of honeycomb coils everything in the range of radio is brought into your home. Consists of a 3 coil mounting and 3 variable condensers of proper capacity. Tuning extremely sharp. Remler dials.

WITHOUT DETECTOR $35.00

THE WILLIAM B. DUCK CO., 224-228 Superior St., Toledo, Ohio

Great Inventors Now Teach You How to Invent

How to develop, patent, and market your ideas; amazing new course teaches science of invention by mail.

Every man, woman, and child is born with *creative imagination*. Some develop this faculty to a greater degree than others, and those who develop it to the *greatest* extent are successful inventors. Invention is an orderly process of the mind, which combines two or more known facts to produce a new fact. Anyone who develops the right mental process can become an inventor. Every successful inventor has this type of mind, developed by constant experience over a period of perhaps many years. Heretofore those who succeeded in the field of invention had to discover all the principles themselves. But, now, just as any student of medicine, law, or engineering can take full advantage of all the recorded experience in these fields of study, so can YOU take the same kind of short cut to the habits of thought, and the methods of work required of successful inventors.

Raymond Francis Yates author of the New Course in Inventive Science, in collaboration with 15 other inventors. Mr. Yates is known thruout the country as Editor of scientific magazines, writer of hundreds of articles and inventor of many practical devices and machines.

Little Inventions Win Fortunes

Fortunes have been made by men who have thought of a "little" idea in a flash. The man who invented the bottle top, the man who invented the crimped hairpin, the man who invented the thin lead automatic pencil, the man who invented the snap fastener—all these men, perhaps, got their ideas in a flash, and founded their fortunes as a result of a single idea. But in every case their minds operated in accordance with the scientific laws of successful invention.

Edison says, "Invention should be taught as a profession." Every inventor realizes the hopelessness of groping in the dark for the habits of thought and methods of work required for successful invention. Trying to invent without knowing the fundamental requirements of invention is like trying to build a bridge without knowing engineering.

Don't Waste Ideas!

Every man at some time or other has an idea for something he would like to invent, but his mind doesn't know how to work. He doesn't know what to do about it—doesn't know how to think along inventive lines — and soon someone whose mind is trained along inventive lines invents just the thing you may have thought of.

WRITE FOR FREE BOOK

A wonderful book explaining this wonderful new course in detail has been written and will be sent free to those genuinely interested. This book explains the course in detail, and proves that anyone can become an inventor who trains his mind --it may be the beginning of a fortune for you. If you have ever had an idea for an invention, or if you would like to become a spare-time or professional inventor, and if you would like to know what to invent, send in your name at once on the coupon--NOW!--Only a limited number of these books are available for free distribution.

Bureau of Inventive Science
Dept. 22, Wisner Bldg.
Rochester, N. Y.

Please send me your free book, "The Science of Invention."

Name_____

Address_____

City_____

State_____

Bureau of Inventive Science, 22 Wisner Bldg., Rochester, N.Y.

4 Weeks' Trial **Direct From Factory**

NOT ONE CENT IN ADVANCE
Wing Pianos and Player Pianos shipped on 4 weeks' trial freight prepaid. Save 25 to 50 per cent. 40 year guarantee. Thousands in use everywhere. Write at once for new book showing 38 styles. Also latest factory prices and easy terms.
WING & SON (Est. 1868). Dept. 202, 9th Ave. & 13th St., New York

High Frequency Apparatus

By T. S. CURTIS

This book covers the design, constructions and practical application of all kinds of high frequency apparatus for use in experimental, medical and plant cultivation work, and also includes directions for the construction of a complete stage outfit for both low and high potential work.

266 pp., illus. Price, $3.00

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

THE HOME WORKSHOP

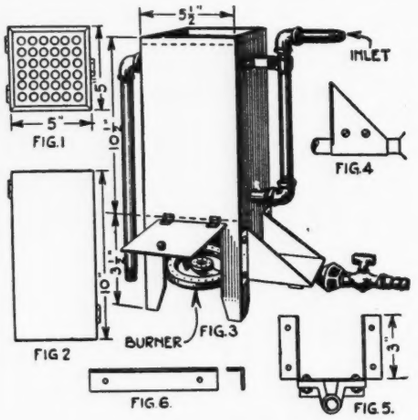
Constructing a Gas or Kerosene Heater

By Clifford A. Butterworth

THE ordinary type of gas water-heater connected with a boiler either alone or in combination with a coal-range has the disadvantage that unless the gas is left burning constantly, a small amount of hot water, perhaps to wash a pan of dishes or a few clothes, cannot be obtained without burning enough gas to heat all the water in the boiler.

The small heater in the accompanying drawings is intended to be operated independently of the boiler, and while it is not instantaneous in action, it will heat a small quantity of water quickly with a minimum amount of gas. As it is not to be operated under pressure, it is simple in construction and can be easily made by the handy man who has some knowledge of sheet-metal work and soldering.

The fire-tube type of design has been followed, and the heater, while only 5 in. square and 10 in. high, has nearly 3¼ sq. ft. of heating surface. The shell of the heater, Figs. 1 and 2, is 18-gage copper. The tubes, of 22-gage brass, ½ in. outside diameter, are spaced ¾ in. between centers. In making the shell, the holes for the pipe bushings should be cut before the metal is bent. The edges are turned over ¼ in. at the top and bottom. The seam is not clinched, but simply lapped ½ in. and soldered. It is best to have the drilling of the heads done by a machinist, if possible, to insure accuracy. After the shell is made, the heads are inserted and soldered in place. The tubes should be cut long enough to project ⅛ in. at each end. For soldering in the tubes it is best to use a blowtorch, as it will do the work quicker and the thorough heating insures the solder running into the joints well. After the tubes are in, the pipe bushings can be soldered in place.

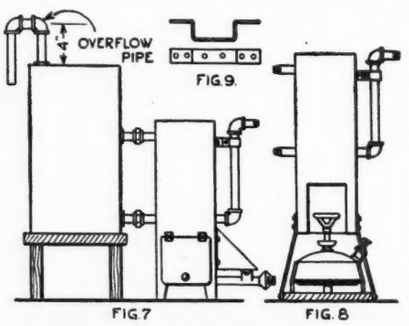


Assembled heater and details

The casing, Fig. 3, is made of galvanized iron, 5½ in. square and 16 in. high. The opening at the bottom is 3½ in. wide and 5 in. high. Similar openings are cut on each side, but are only made 1½ in. high. Before the heater is put in the casing, it is wrapped with three or four thicknesses of thin sheet asbestos. It rests on two supports shaped as shown in Fig. 6.

The burner can be taken from an old gas-stove or gas-plate, but it should be one that throws the flame straight up rather than sideways. The bracket to which it is fastened is shown in Fig. 5. In case there is no lug for the bolts on the burner, the bracket shown in Fig. 4 can be used. The inlet pipe is run up level with the top of the heater so there will be no chance of the water running out of the heater when the supply is shut off. The two outlets are provided to prevent any possible increase in pressure through the water not being able to escape fast enough or from steam. In no case must valves be put on the outlet pipes.

The heater can be put on a shelf near the sink or mounted on brackets made of 1 by ⅛ in. iron shaped as in Fig. 9 so that the heater will be 2 or 3 in. from the wall. The simplest way of connecting the heater with the water supply is to use a hose or rubber tube that can be slipped on the faucet when the heater is to be used. The heater is so small.



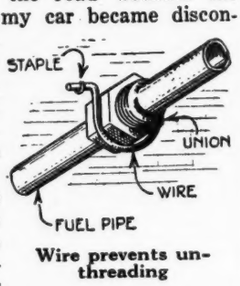
Boiler connections and kerosene heater

It is also possible to connect the heater to a small tank, Fig. 7, so that a quantity of water can be kept hot as long as desired. The tank is 7 in. in diameter and 14 in. high and holds about 2 gal. but any larger size up to five gallons may be used. It is set up so that the bottom comes on a level with the bottom of the heater. The outlets on the heater are arranged at the top and bottom.

In case gas is not available, a small kerosene pressure stove can be used to provide heat, as shown in Fig. 8. If it is to be used this way, the casing need not be made so long, as it will be necessary to have the burner nearer the bottom of the heater, which in this case is supported over a sheet-metal base on four pieces of 1 by ⅛ in. iron.

Fastening the Gasoline Line

AT two different times I was nearly stranded on the road because the gasoline pipe on my car became disconnected at the union next to the tank. By the expedient here described I prevented a reoccurrence of the trouble.



Wire prevents unthreading

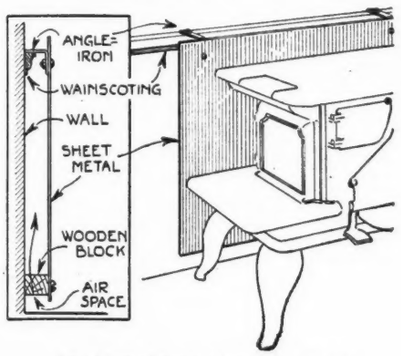
I measured the distance from the floorboards to the bottom of the union where the pipes are connected and cut out a cardboard form of the shape of the union. This form I used as a pattern for bending a piece of stiff wire that I tacked to the under side of the floorboards and that made a snug fit around the union. Staples were used for fastening.—L. B. ROBBINS.

THE HOME WORKSHOP

Metal Shield Protects Wall Behind Coal-Range

THE woodwork or wall behind the kitchen range often gets very hot. Houses have sometimes been burned down just because the stove was placed too close to the wall. After a narrow escape from having a house destroyed in that way, the writer constructed the shield shown in the illustration, and it has proved an efficient safeguard.

The shield is made from a sheet of galvanized sheet steel 30 in. wide and 1 ft.



Method of fastening the shield

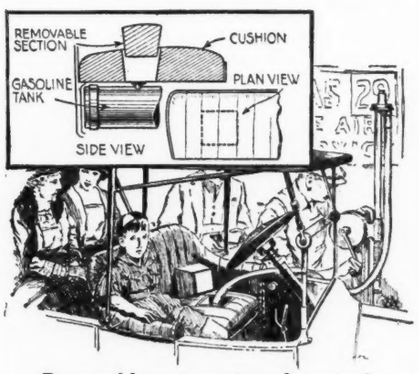
longer than the range. The supports are small angle-irons with legs 2 or 3 in. long. These are attached to the sheet metal with stove-bolts about 2 in. from the top and fastened to the upper edge of the wainscoting with screws.

Two blocks of wood are fastened near the lower edge to hold the shield out from the wall at the bottom. This forms an insulating space through which the air continually circulates and protects the wall from overheating.—W. S. STANDIFORD.

Gasoline Tank Filled through Hole in Seat Cushion

IN order to facilitate the filling of the gasoline tank, where it is located under the front-seat cushion, a method less inconvenient than that requiring the passengers to move, consists in cutting out an 8-in. square section of the seat.

A piece of seat-covering material is stitched about the inside of the opening



Removable seat section above tank

and the section cut out is similarly covered.

When it is desired, this section is pulled out and the funnel inserted or the filling-hose is placed in the tank without requiring the passengers to get out of the car.

This saves the inconvenience, especially in rainy or snowy weather, attending the replenishment of the fuel.—G. A. LUERS.

WANTED IDEAS

Inquiries from Manufacturers and Other Buyers of Patents Who Are Looking for Good Ideas

Protected by Owen Patents

are constantly being received. Manufacturers are always interested in any new device for which there is a market, which fills a long felt need, which makes production possible at a lower cost, or which will do the work **better.** Extracts from some of the more recent letters received are printed herewith. There is undoubtedly a great demand to-day for really worth while inventions.

CAN YOU HELP?

Here are abstracts from a few recent requests I have received from those who wish to buy, finance or manufacture good inventions. Have you an idea that will fill the bill?

The following is an extract from letter dated July 20, 1921, from a middle western manufacturer whose volume of business last year was approximately $1,000,000. "If you are in touch with any meritorious proposition that is seeking manufacturing facilities, whether in the automotive or some other good field, we shall be very glad to have you place us in touch with it. We are willing to consider an outright purchase of patents, etc., or to manufacture upon a royalty basis."

Another very interesting request, from a large corporation, dated June 27, 1921, follows: "Should you have clients whose inventions are worthy of commercial manufacture and exploitation, we shall be glad to consider the financing of such projects if they are interesting. In that event, we indicate also that we are identified with two large machinery manufacturing plants located, respectively, in Bridgeport, Connecticut, and Providence, Rhode Island. These plants, besides having their own foundries, are thoroughly equipped to manufacture anything from a small lathe to a complete automobile. Whether your clients have mechanical inventions or otherwise, we shall be pleased to hear of any proposition requiring financing, which we beg to assure you will receive courteous and appropriate consideration."

Another letter dated April 28, 1921, from a large corporation whose officers include some of the best known men of the country, says in part: "We are in the market for an invention of merit possessing undoubted economic and commercial value combined with ADEQUATE PATENT PROTECTION."

YOUR FIRST STEP

If you have an idea, send immediately for my blank form **"To Record Your Invention."** You should serve your own best interests by filling out and signing this form before you disclose your invention **to any one.** This document will help you determine and establish evidence of invention before filing an application in the U. S. Patent Office. A copy, with full instructions, will be gladly sent free on request.

New Book "SUCCESSFUL PATENTS" Sent Free

Every man who has an invention, or ever hopes to have one, should send for a copy of my book **"Successful Patents."** It tells what everyone should know about patents, trade-marks, copyrights, etc. It describes my methods, fees and terms, gives information relative to assignment or sale of rights, and instructions in detail. Mail coupon to-day for a free copy of this book—or a postcard request will do.

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection, and will endeavor to aid him in the commercial development of his proposition—my service is distinguished by over 12 years' successful practice, and by thousands of satisfied clients and by reasonable fees.

Send sketch, or model, and description, for advice as to cost, opinion as to its patentable nature, etc. Preliminary advice gladly furnished without charge.

RICHARD B. OWEN, Patent Lawyer, Branch Office: 2276D, Woolworth Building
Main Office: 6 Owen Building, Washington, D.C. New York City

Please send me, without charge, or other obligation, a copy of your book "SUCCESSFUL PATENTS," your form "TO RECORD YOUR INVENTION," and information concerning patents, etc.

Name .....

Address .....

The Other Day I Was Watching Two Fellows Exercising in a

Gymnasium—one was straining desperately to do the same feats of strength his companions were accomplishing, but his efforts were in vain. He did not have the physique and his methods were entirely wrong. Close by, however, was a robust man whose every muscle smoothly rippled as he went through his exercising as though it were child's play. Being a great admirer of strong men and proper training methods, I introduced myself to this second man and asked him where he had learned the knack of muscular contraction.

EARLE E. LIEDERMAN
The Acme of Physical Perfection

He grabbed my hand and exclaimed, "Why, Mr. Liederman, I'm mighty glad to meet you, I'm one of your pupils." He turned out to be Arthur Lawrence, one of New York's well known strong men.

ONLY ONE OF MANY

Hardly a week passes that I do not hear of such cases. It would take volumes to contain the thousands of letters of thanks which stream into my office. My pupils are my best arguments that the Liederman progressive system is the sure road to perfect "Muscular Development."

The Answer Is Simple

Why did these two men work side by side with such opposite results? One apparently worked harder than the other but he burned up his vitality and destroyed his body, while the other had learned the science of muscular contraction, which not only brings about a rapid increase in the development of muscles, but makes it possible to accomplish just about double the results with the same amount of development. This is the secret of my own success. After years of scientific study and application, I discovered the true basis of muscular development and applied it to my own body. The result was astounding. Just imagine a system that would do twice the work of any other in less than half the time. It is this very system that I am now imparting to others. My pupils are among the leaders in both the athletic and business world. One recently was given a single prize of $1,000 in a contest for the most perfect man, while many are living a life of ease through the money they receive by teaching others.

DON'T DELAY

"He who hesitates is lost"—Save yourself from a life of misery and despair. Let this day be the start a new life and a bigger one. Success is knocking at your door. Do not turn her away for she has big things in store for you. Strength, health and happiness. The man who succeeds is the one who obeys that impulse.

The Eighth Edition of My Latest Book :

"Muscular Development"

is just off the press. It contains 26 full-page photographs of myself and some of the world's best developed athletes, whom I have trained. These men are not only perfect specimens of physical manhood but are noted successes in their business careers. *I want every one who reads this page to send for a copy of this book.* It will interest you, it will educate you, it will inspire you to bigger and better things. It is free. I simply ask you to send me 10 cents in stamps or coin to help cover the cost of wrapping, packing, mailing, etc. Do not put this off, for this little book may be the turning point of your whole life. *Sit down right now, this very minute, fill out the coupon and send for it while it is on your mind.*

EARLE E. LIEDERMAN
Dept. 1302 305 Broadway, New York

EARLE E. LIEDERMAN
Dept. 1302, 305 Broadway, New York

Dear Sir: I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name .....

Address .....

City ..... State .....

THE HOME WORKSHOP

Regulating Furnace Dampers from all Floors

BY the use of chains, pulleys, and levers it is possible to control the furnace drafts from any or all floors of your house. The installation will take a little time and care, but it will be durable and positive in action and will not be expensive, especially if homemade regulators of wood, brass, or iron are made in place of the ordinary commercial wheel regulators.

In the purchased regulators the chain passes around a flanged wheel and is anchored at the top, so that turning the adjusting handle in one direction will open the draft and close the damper, and in the other direction will do the reverse. Take care in extending the chains to the upper floors to make the attachment 4 in. or more below the center of the wheel, and do not let the chains sag.

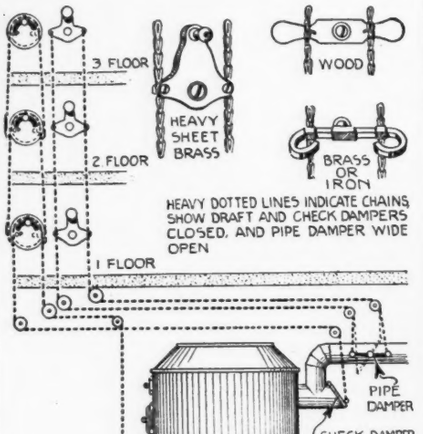


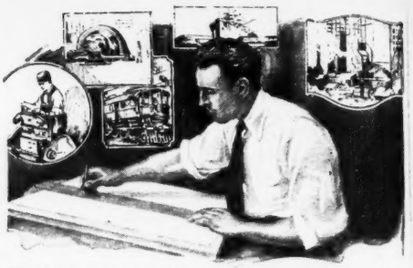
Diagram of draft and damper controls

The homemade regulators, which are illustrated, work even more directly, because the chain is continuous from the furnace to the top floor. All the regulators will move in unison when any one of them is operated. In the furnace-room it is well to have a heavy ring attached to each chain so that the draft and damper can be operated by pulling the chain, taking care always to pull toward the furnace on the one to be closed and never away from the furnace on the one to be opened. The pipe damper should be operated independently of the others by attaching an 8-in. handle and fastening the chains to each end of the lever.—LEROY CRIGLER.

Gasoline in Vulcanizer Warms the Cold Motor

YOU do not need to exhaust yourself cranking the motor of your machine if the storage battery has run down and the cold prevents the gasoline from vaporizing readily. Simply put a teaspoonful of gasoline in the vulcanizer, catch the edge with pliers and, after lighting, hold it under the upper part of the intake manifold.

A cold-weather hint



WE'LL TRAIN YOU as Drafting Specialist *FREE*

EARN $35 TO $100 A WEEK

After you have completed our Course in Drafting (mechanical drawing), we will give you free training in your choice of one of our courses in a specialized branch of drafting.

WHAT YOU GET *FREE*

We also furnish you free with complete drawing and drafting equipment when you enroll for our Course. Free consultation privileges at any time, during your course or after you've taken your position. We help you to get a position as draftsman and send you free subscription to Draftsman's Publication "The Compass."

FREE BOOK: Write to-day for free book, "Your Future in Drafting," giving details of our home study course in drafting and telling how you can qualify for a position paying $35 to $100 a week.

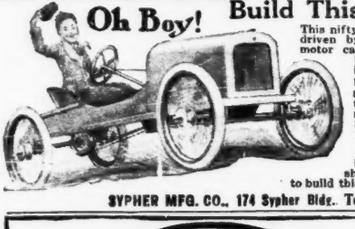
ROY C. CLAFLIN, President
COLUMBIA SCHOOL OF DRAFTING
Dept. 1608, 14th and T Streets, N. W., Washington, D. C.

SEXUAL KNOWLEDGE

ILLUSTRATED
By WINFIELD SCOTT HALL, M.D., Ph.D.
SEX FACTS MADE PLAIN
What every young man and Every young woman should know
What every young husband and Every young wife should know
What every parent should know
Cloth binding—320 pages—many illustrations
Table of contents, & commendations, on request.

$1.00 Postpaid Mailed in plain wrapper

AMERICAN PUB. CO., 217 Winston Bldg., Philadelphia



Oh Boy! Build This Car

This nifty little car driven by gasoline motor can be built by any boy. New plans, bigger, better than ever, now ready. Send 30c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO., 174 Sypher Bldg., Toledo, Ohio

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—**"Inventions and Trade Marks, Their Protection and Exploitation"** and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. **A postal will do—it is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.
201 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE
In INVENTION And MANUFACTURING SUPPLEMENT.

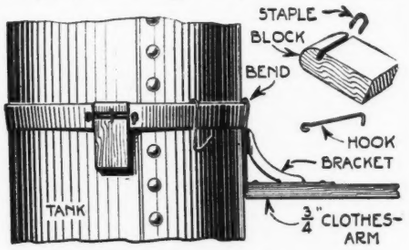
Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

THE HOME WORKSHOP

Clothes-Drying Rack on the Hot-Water Tank

BEHIND or at the side of the stove is the most suitable place to dry clothes, but the hot-water tank is usually in the way. There is a way to get around this easily with an iron barrel-hoop about 1½ in. wide. Cut this hoop 1½ in. shorter than the circumference of your tank. Punch a nail-hole ¼ in. from each end, bending the ends at right angles. With a stiff wire, such as the bail of a lard-pail, make the 2-in. connection, fasten one end of the wire into a nail hole in the hoop and bending the other end into a hook shape as shown.

Cut a 1-in. square wooden block 2 in. long, and round off one end like a half circle. At one end saw a ¼-in. slot as shown in the illustration. Connect the wire, with the longer circumference of the



Clothes-arm attached to the tank

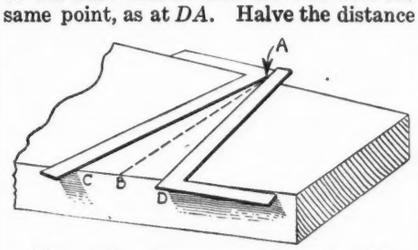
hoop uppermost around the tank, slip the round end of the block between the hoop ends to catch the wire in the saw-slit, and turn over and down against the tank side. Drive a double-end tack into the block over the wire to hold all parts together when not in use.

Wire hooks and wooden arms are hung on the hoop as shown. Bend the hooks from heavy wire. Construct a clothes-arm with a 4 by 5 in. steel shelf bracket and a wooden strip about ¾ in. square and as long as you like. Bend over 1 in. of the 5-in. side of the bracket to catch on the hoop; screw the other side to the wooden arm. Sandpaper and enamel the hoop.

To remove this attachment, turn back the wooden block and slip the hoop end off the wire connection.—R. B. CUTLER.

To Square Tapered Timber Follow This Method

WHEN the two edges taper evenly, lay your square so that the back is at the point you want to cut, as at *AC*, reverse it to the other side so that the end cuts the same point, as at *DA*. Halve the distance



To get the square cut AB, make BC equal to BD

between *D* and *C*, which will give you the line *AB*, square across.

If you have a bevel square, you may set it at any angle to get *AB;* then set it to that line to square the other sides.

Should the two sides taper unevenly, you will have to strike a center line up and down the timber and square from that.

PATENTS TRADE-MARKS AND COPYRIGHTS

SPECIAL OFFER FREE OPINION AS TO PATENTABLE NATURE

Before disclosing an invention, the inventor should write for our blank form **"Record of Invention."** This should be signed and witnessed and if returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

Our Three Books Mailed Free to Inventors

Our Illustrated Guide BOOK

HOW TO OBTAIN A PATENT

Contains full instructions regarding Patents, Trade-Marks, Foreign Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Patent Practice and Procedure, and Law Points for inventors.

OUR TRADE MARK BOOK

Shows the value and necessity of Trade-Mark Protection and gives information regarding unfair competition.

OUR FOREIGN BOOK

We have Direct Agencies in all Foreign Countries. Write for our illustrated Guide Book on Foreign Patents.

SPECIALIZATION Our Staff

The field of invention is so vast that it is impossible for any one to become an expert in all the different classes of invention. Only those skilled in the class to which the invention relates are capable of rendering efficient service. For this reason Victor J. Evans & Co. employ a number of patent lawyers and mechanical experts who have been selected for their special knowledge and ability in certain lines of invention. Each case is placed in charge of experts in the classes in which the invention relates.

THE VALUE OF YOUR PATENT

Will depend much upon the skill and care with which your case is prosecuted in the United States Patent Office. We spare neither time nor pains to secure the broadest possible patents that the inventions will warrant. That every case entrusted to us receives our best efforts, and that our work is done consistently, skillfully and thoroughly is evidenced by the many unsolicited letters of commendation that we receive constantly from our clients. We will furnish upon request lists of clients from any State in the Union for whom we have secured patents.

Our New York, Philadelphia, Pittsburgh, Chicago, and San Francisco Offices

Owing to the growth of our business we have established for the benefit of our clients Branch Offices in New York City, Philadelphia, Pa., Pittsburg, Pa., Chicago, Ill., and San Francisco, Cal. These branch offices being located in these large commercial cities, together with our Main Office located near the U. S. Patent Office, in Washington, enables us to more promptly handle the business of our clients, particularly as the branch offices are in constant touch with the Main Office and fully equipped to handle patent business in all its branches.

Highest References—Prompt Attention—Reasonable Terms

FREE COUPON

VJE Co

VICTOR J. EVANS & CO.
Patent Attorneys

New York Offices 1007 Woolworth Bldg. Philadelphia Offices 135 S. Broad Street Pittsburgh Offices 514 Empire Bldg.
Chicago Offices 1114 Tacoma Bldg. San Francisco Offices, Hobart Bldg.

Main Offices, 760 9th Street, Washington, D. C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....Address.....

PATENTS

IF YOU HAVE AN INVENTION *and* DESIRE TO LEARN HOW TO SECURE A PATENT, send for Our Guide Book, HOW TO GET A PATENT, sent Free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

NAME.....
STREET.....
CITY.....STATE.....

PATENTS

Booklet Free — Highest References
Promptness Assured — Best Results

Send drawing or model for preliminary examination of Patent Office records and report as to patentability

All Business Given Prompt and Proper Attention

WATSON E. COLEMAN, Patent Lawyer,
624 F St., Washington, D. C.

Don't Wear a Truss

MR. C. E. BROOKS

Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.

Brooks' Rupture Appliance

Has automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.
Brooks Appliance Co., 255D State St., Marshall, Mich.

PATENT-SENSE
The Book for INVENTORS and MANUFACTURERS

SIXTH EDITION

PATENTS

A Hand-Book of Essential Information and Advice relative to Patents, Trade-Marks; Assignment, Sale or Licensing of Rights; Abstracts from Leading Decisions; State Laws on Patent and Trade-Mark Property. FREE! Write
LACEY & LACEY
Established 1869
Dept. B, Washington, D. C.

BIG VALUE for 10 Cts.

6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Joke Book; 1 Book on Love; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Base Ball Book, gives rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 3 Puzzles; 12 Games; 30 Verses for Autograph Albums. All the above by mail for 10 cts. and 2 cts. postage.
ROYAL SALES CO., Box 433, South Norwalk, Conn.

PATENTS

Send us sketch or model for patentability opinion and exact cost of patent. Our book "How to Obtain a Patent" Sent Free on request. It tells how to apply for Patents, Trade Marks, Foreign Patents, Copyrights, etc.; gives information on Patent Procedure; tells what every inventor should know. Thousands of Inventors, who are our clients, are our references.
CHANDLEE & CHANDLEE, 25 Years' Experience
427 7th St. Washington, D. C.

PATENTS

TRADE-MARKS — COPYRIGHTS

Send for our free book of patent information

Beale & Park 864 F St., Washington, D. C. 16 S. Broad St., Philadelphia, Pa.

Inventors

in all cities and many towns in the United States and Canada have secured patents through us. We secure patents in **delayed, neglected** and

Rejected

cases. Write giving data. Our fee will be contingent on success.

Abraham Lincoln in an Address to Law Students said:

"As a rule, never take your fee in advance, nor any more than a small retainer. When fully paid beforehand, you are more than a common mortal if you can feel the same interest in the case as if something was still in prospect for you, as well as your client; and when you lack interest in the case, the job will very likely lack skill and diligence in the performance."

Engaged in **Patent Soliciting exclusively since 1875, we have procured more than 40,000**

Patents

Send us a model drawing or a photo with description of invention, remit $5.00 for search in U. S. Patent Office. If we report invention patentable, we will back our judgment and keep no attorney's fee unless patent is obtained.

Our booklet on patent protection at home and abroad sent free. Write Dept. M or come to us

C. A. SNOW & Co., Patent Attorneys
710 8th St., Opp. North Front of U. S. Patent Office
WASHINGTON, D. C.

U.S. PATENTS

DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"EVIDENCE OF CONCEPTION"** to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them,—a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE

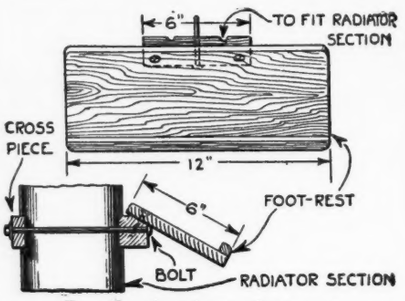
274 Ouray Bldg.
WASHINGTON, D. C.
Originators of forms "Evidence of Conception."

THE HOME WORKSHOP

Attach a Foot-Rest to the House Radiator

THIS useful foot-rest attachment for the radiator may be made in a short time at practically no expense. It is extremely convenient and may be attached or detached in a few moments.

A piece of attractive dressed oak or other neat lumber is used for the foot support, which is 6 in. wide, 12 in. long, and about



Details of rad.ator foot-rest

¾ in. in thickness. A piece of neat molding strip is placed along the bottom as a cleat to catch and support the heels.

A piece of dressed board 2 in. by 2 in. 6 in. in length, is used as a base piece to carry the support and to hold all against the side of the radiator. This piece is smoothed down and shaped as shown. Cut notches into one side so that it will fit against the side of the radiator. These notches will make the whole support rigid and prevent it from turning or shifting from its original position.

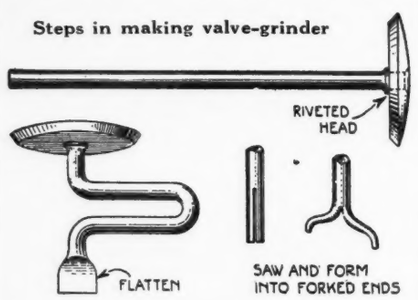
A long bolt or small rod, threaded on each end to receive a nut, is used to clamp the support to the radiator. This is accomplished by passing the bolt or rod through the space between the sections of the radiator and through a small piece of board at the rear. A thumb nut is best used as a clamping medium, as it is easily turned without the aid of a wrench.

Fasten the foot-rest board to the support block with screws and varnish or paint to match the radiators.—B. F. DASHIELL.

Improvising a Valve-Grinder from a Worn Valve

IF you have among the accumulated odds and ends in your workshop an old valve with a riveted head, you may easily turn it into a useful valve-grinder. If the head of the valve is not already loosened, tap

Steps in making valve-grinder



it a few times with the hammer, until the head freely turns around its axis.

Bend the stem of the valve into the shape of a hand brace, as shown in the illustration, and then either flatten the end to fit the slot of the valve head or cut it as shown and bend the ends to form a fork.

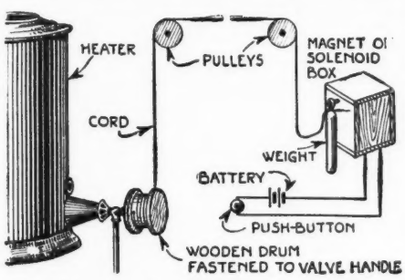
THE HOME WORKSHOP

Turn on Gas Water-Heater by Pressing Button

HOME workers who like to design and construct automatic mechanisms may find a suggestion in this device for turning on a gas water-heater in the cellar by pressing a button on an upper floor. The same principles might be applied to other uses.

A small wood drum, easily made, is attached to the gas-valve wheel by staples.

A piece of twine, attached to this drum and wound around it several times, is led over pulleys and fastened to a weight. This weight normally hangs from the protruding rod on the magnet or solenoid box



Pushing the button turns on the gas

and the gas supply may be regulated by turning the drum.

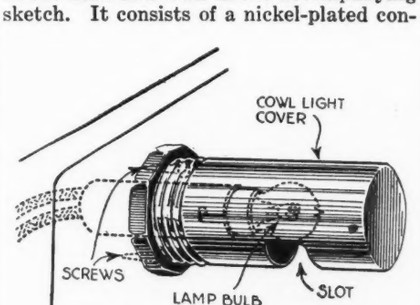
Turn the gas quite low before going to bed or at any time during the day when there is no longer need for hot water, allowing only sufficient flame to keep the water warm.

When the alarm-clock rings in the morning, press the conveniently located push-button. This completes the circuit, energizes the magnets or solenoid, draws back the plunger, and allows the weight to fall. That, in turn, opens the gas-valve, and water is quickly heated.

The construction of the weight-releasing device may be varied to suit available material. A spring should return the plunger upon releasing the button.

Shaving-Stick Holder for the Cowl Light

AN improvised cowl-light fixture for a Ford or other small car may be added to the dash as shown in the accompanying sketch. It consists of a nickel-plated con-

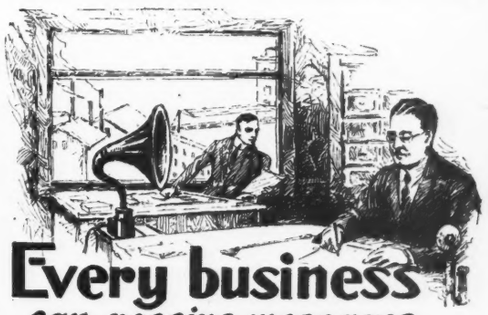


How the holder is slotted and fastened

tainer such as is supplied with some shaving soaps.

A rectangular slot is cut in the longer section and the base is screwed to the dash. A lamp socket of the bayonet type is placed within the base and the wires are run out at the back.

The body is detachable, permitting the renewal of the lamp when it becomes necessary.—G. A. LUERS.



Every business can receive messages by Wireless

At no more than the cost of an ordinary phonograph, a complete wireless receiving set can be purchased and installed in any home or place of business in one hour's time.

The Radio MAGNAVOX makes such a set practical and profitable for business purposes in receiving news bulletins, market reports, and other communications by radio. It talks plain English. Any one can operate it. And practically the only limit to the receiving range is the power used at the transmitting terminal.

Ask any radio dealer, or mail the coupon below for full particulars.

The Radio MAGNAVOX is the most important part of a wireless receiving set. It eliminates the use of head sets. It simplifies the use of the receiving set. It reproduces messages, music, conversations, reports, etc., without distortion, in any volume desired so any number of persons may receive them simultaneously. Any one can operate it the first day without previous knowledge or training. Complete instructions free with each outfit. Make sure it's a MAGNAVOX — DO NOT ACCEPT A SUBSTITUTE.

MAGNAVOX COMPANY, OAKLAND, CALIFORNIA
New York Office: 370 Seventh Avenue, Penn. Terminal Bldg.

GENTLEMEN:—
Please send me prices and full particulars concerning the Radio *Magnavox* outfit for use with a receiving set in reproducing wireless music and wireless conversations.

NAME_____
ADDRESS_____

5 Master Keys

Only keys of their kind in existence—(patented). **Open and test thousands of different locks.** Tell you instantly if your door or padlocks are burglar proof. Serve in emergencies, too. Thousands of sets in daily use among detectives, policemen, contractors, locksmiths, firemen, mechanics, travellers, home and hotel owners, etc. Give feeling of security and protection worth many times their cost. **Novel key chain FREE.** Send $1 today. **Master Key Co., 41 Manhattan Block, Milwaukee, Wis.**

Print Your Own

cards, circulars, labels, tags, menus book, paper. Press $12. Larger $35. Job Press $150 up. CUTS EXPENSE IN HALF. SMALL OUTLAY. Pays for itself in short time. Will last for years. Easy to use, printed rules sent. Print for others, BIG PROFIT. Write factory TODAY for press catalog, TYPE, cards, paper, envelopes. **THE PRESS CO., D-33, Meriden, Conn.**

CLASS PINS

FREE CATALOG GIVE NAME OF SCHOOL OR CLUB AND NUMBER IN CLASS

Either pin illustrated made with any 3 letters and 2 figures, one or two colors enamel. Silver plate, 20¢ ea., $2 00 doz. Sterling silver, 40¢ ea., $4.00 doz. Write for new catalog.
BASTIAN BROS. CO.
390 Bastian Bldg. Rochester, N. Y.

High School Course in 2 Years

You can complete this simplified High School Course at home inside of two years. Meets all requirements for entrance to college and the leading professions. This and thirty-six other practical courses are described in our Free Bulletin. Send for it TODAY.

AMERICAN SCHOOL
Dept. H-275 Drexel Ave. & 58th St. CHICAGO

BOYS! BOYS! BOYS!

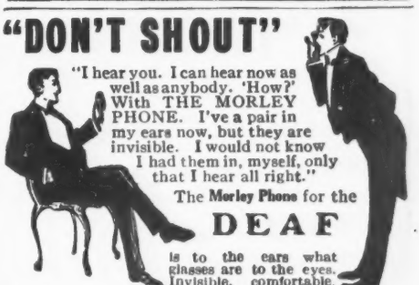
THROW YOUR VOICE

Into a trunk, under the bed or anywhere. Lots of Fun fooling the Teacher, Policeman or Friends.

THE VENTRILO,

a little instrument, fits in the mouth out of sight, used with above for Bird Calls, etc. Anyone can use it. **NEVER FAILS. Also a 32 PAGE BOOK** which gives full instructions on Ventriloquism. Formula for Secret Writing [Invisible Ink], 12 Money Making Secrets and **10 BIG TRICKS ON MAGIC** all for **10¢**
ROY. NOV. CO., Dept. 351 So. Norwalk, Conn.
LARGEST and OLDEST Mail Order House in Connecticut.

"DON'T SHOUT"



"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The **Morley Phone** for the

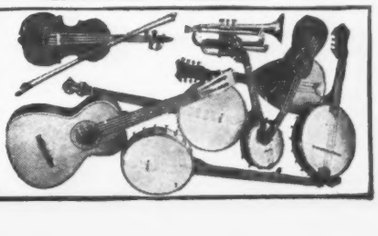
DEAF

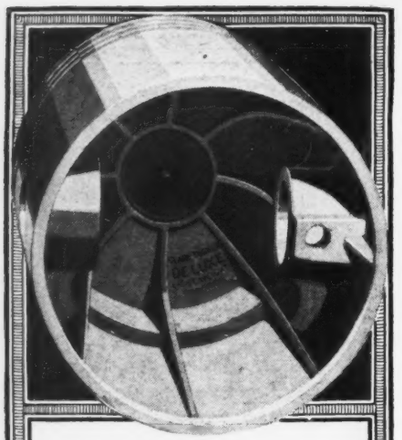
is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.
THE MORLEY CO., Dept. 707, 26 South 15th Street, Philadelphia

FREE PROFESSIONAL TONE MUSICAL INSTRUMENTS

and lessons sent on free trial. Violin, Tenor Banjo, Hawaiian Guitar, Ukulele, Mandolin, Cornet, Banjo Mandolin, Banjo Ukulele, Guitar, Banjo Guitar, or Banjo. Wonderful new copyrighted system of teaching note music by mail. Four lessons will teach you several pieces. Over 100,000 successful players. Do not miss this **free** trial offer. Write for booklet. No obligations.

SLINGERLAND SCHOOL OF MUSIC, Inc.,
1815 Orchard Street, Dept. 135, Chicago, Illinois





Look Inside

See the scientific patented reinforcing ribs? They make DELUXE light weight cast iron pistons 40 to 50% lighter than ordinary stock factory cast pistons and stronger where strength is needed.

DELUXE pistons make old motors run like new ones and new ones better,—increasing power, speed, flexibility and economy,—because they have less expansion, greater cooling surface and can be fitted closer. They eliminate vibration, oil pumping, gas leakage and piston slap, and save gas, oil and upkeep.

Your dealer can get DELUXE pistons for any model motor in 24 hours or less.

Clark-Turner Piston Co.
(Inc.)
Los Angeles, California

Construction of Induction Coils and Transformers, by Thomas Stanley Curtis. Full of practical notes and instruction. Tells you both the why and the how. Little is left to guess work. Open and closed core transformers are both taken up. For a practical instruction book on the whole subject this one is hard to beat for the price. **Price,** postpaid, **25 cents**

POPULAR SCIENCE MONTHLY
225 West 39th Street New York

MONARCH JUNIOR LATHES

"The Biggest Little Lathe Built"

A REAL engine lathe—small, sturdy, compact, low-cost—guaranteed to do all small work with 1/1000 of inch accuracy. Built with the same care and precision that made **MONARCH ENGINE LATHES** the world's standard of quality and efficiency.

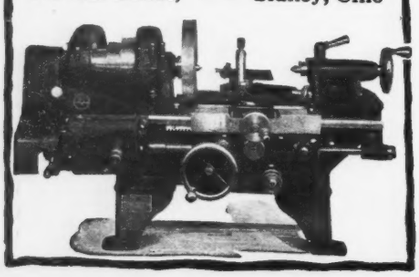
The **MONARCH JUNIOR** is ideal for beginners. Occupies small space in your own home or shop. Easy and economical to operate. Simple and trouble-proof, automatic safety features. Fully equipped.

The Greatest Achievement in Lathe Building History

Monarch Junior 9 inch Engine Lathe **$225**

Full particulars and a Monarch Junior Catalog will be sent you on request.

The Monarch Machine Tool Co.
201 Oak Street, - - Sidney, Ohio

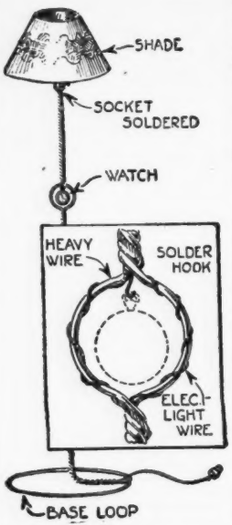


THE HOME WORKSHOP

Novel Floor-Lamp with Watch-Loop

A CONVENIENT floor-lamp as a means of illumination is quite as necessary in the household as any lighting device, and a desirable one can be made quite inexpensively.

The picture shows one about 4 ft. tall, with a base of 15 in. diameter. It is made of a length of wire (either No. 6 or No. 4, copper) about 13 ft. long. The amount of twist in the turns, the size of the watch-loop and the desired height of the lamp may vary this length a few inches, but 13 ft. will make a very convenient height for most purposes.



The watch-loop and complete lamp

Find the center of the wire, or, in this case, 6 ft. 6 in., and form a 15-in. diameter circle for the base. Where the wire meets, start twisting by holding the circle firmly between two planks or in a vise.

The two ends of the wire inserted through holes bored close together in the side, near the end of a flat hard-wood stick, with a foot or two of length for leverage, will be found an excellent way to do this operation, and uniform turns can be accomplished without scratching the wire.

Where the watch-loop is made, leave about 6 in. of each wire to form the circle. After this is made, catch the wire by this circle in the vise, and proceed twisting the remainder of the length.

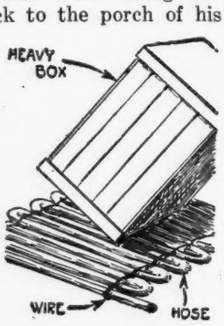
At the top of the watch-loop, a small hook may be soldered to hang the watch on.

The socket base should be firmly soldered to the twisted wires and then drill two holes through, large enough to accommodate the rubber-covered extension wires without injuring the insulation.

The extension cord should be of particularly heavy rubber insulation because of the method of winding it about the standard.

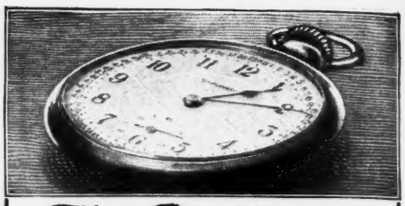
Buffer Mat Made from Hose

TO avoid damage to packages, boxes, barrels, and crates when being unloaded from a truck to the porch of his general store, one merchant improvised a substantial buffer mat from old water-hose, as shown in the illustration. This mat also protects the flooring from splintering and saves in repairs.



Preventing breakage

The hose had outworn its original purpose and was of no value. It was doubled up and fastened with iron wire into a compact mat.



The Burlington 21 Jewels

See it first. We send it for you to look at and examine carefully. You are under no obligation to buy. A 21-jewel watch sold to you at a price a great deal lower than that of other high grade watches.

$5.00 a month

The 21-Jewel Burlington is sold to you at a very low price and on the very special terms (after free examination) of only $5.00 a month. Send today for full information.

Free Book Send for the most complete watch book ever produced, 100 designs and engravings beautifully illustrated in colors. Write for it today it is free. A letter or post card will do.

Burlington Watch Company, Dept. 1362
19th Street and Marshall Blvd. Chicago, Illinois
Canadian Office: 62 Albert St., Winnipeg

Deafness

Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable.

Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
362 Inter-Southern Bldg. LOUISVILLE, KY

Only $45.00 For This Job Complete

Save exorbitant freight rates and one-half original cost by buying Ford Speedster Bodies knocked down. Simple, complete instructions furnished, all parts cut to exact fit. Any one can assemble this job. Complete with hood, radiator shell, instrument board, upholstering, metal parts, wood parts, bolt screws, etc. Flat radiator shell furnished made up. Designed low with lack of wind resistance. Price set up $90, further particulars on request.

Not Paper Patterns All Parts Complete

The Central Auto Supply Co. Eng. Dept. 122 Louisville, Ky.

HOW TO PAINT
SIGNS AND SHO' CARDS

Our book gives a complete course of instructions, enabling any one to learn to paint good signs. WHY NOT MAKE YOUR OWN either for your business or for others?

Contents: Alphabets, Composition, Color Combinations, **How to Mix Paints,** Show Cards, Window Signs, Banners, Board and Wall Signs, Ready Made Letters, Gilding, Commercial Art and Tricks of the Trade—Contains 100 alphabets and designs. Cloth bound, size 7 x 5 inches, **Price $1.00 postpaid.**

J. S. Ogilvie Pub. Co., 206 Rose St., New York

This Book On Home Beautifying Sent Free

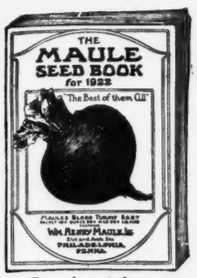
Contains practical suggestions on how to make your home artistic, cheery and inviting—explains how you can easily and economically refinish and keep woodwork, furniture and floors in perfect condition.

--Building??

This book tells how to finish inexpensive soft woods so they are as beautiful and artistic as hard wood. Tells just what materials to use — how to apply them—includes color card—gives covering capacities, etc.

We will gladly send this book free and postpaid for the name of your best dealer in paints. And for 10c we will also send you a 2 oz. bottle of Johnson's Liquid Wax.

S. C. JOHNSON & SON, Dept. PS2, Racine, Wis.
"The Wood Finishing Authorities"



FREE

Send a postal today for your copy of this wonderful 176 page seed book

Complete information about all vegetable and flower seeds (many new varieties), plants, bulbs, nursery stock, tools, insecticides, etc.

MAULE'S SEEDS

Once Grown Always Grown

WM. HENRY MAULE, Inc., PHILA., PA.
2201 Arch Street

LEARN ENGINEERING

Courses, 3 months to 2 years—practical-technical training under experts. Not a Trade School, but a practical-technical college teaching electricity, steam, gas, auto electric, armature winding, drafting. Extensive laboratory and shop. Degrees awarded. Day and night sessions. Enroll any time.

FINLAY ENGINEERING COLLEGE,
1002 Indiana Ave., Kansas City, Mo.

WRITE THE WORDS FOR A SONG

We revise poems, write music and guarantee to secure publication by a New York Music Publisher. Our Lyric Editor and Chief Composer is a song writer of national reputation and has written many big song-hits. Submit poems on any subject. We examine them free.

BROADWAY STUDIOS
249B Fitzgerald Building
Broadway at Times Square New York, N.Y.

MAKE YOUR wife's or mother's wash tub into a **WASHING MACHINE**

It's easy to wash a tub of clothes in 5 to 10 minutes—clean and without wear, with the Vac Cup Attachment, the Semi-Automatic Washing Machine. No electric or water power necessary. Vacuum and suction principle—formerly the Dodge and Zuill Syracuse "Easy." Sent on 30 days' free trial. Easy monthly payments if desired. Send postal card for how to save work. Burlingame Mfg. Co., 2215 Sunset Ave., Syracuse, N.Y.

"BOWLEGS and KNOCK-KNEES" UNSIGHTLY

SEND FOR BOOKLET SHOWING PHOTOS OF MEN WITH AND WITHOUT

The Perfect Leg Forms

PERFECT SALES CO., 140 N Mayfield Ave., Dept. 45, Chicago, Ill.

National College of Chiropractic
(RESIDENTIAL)
Catalogue on Request

16 N. Ashland Blvd. Chicago
Unsurpassed facilities for a complete Scientific Chiropractic education. Distinguished Faculty. Modern and extensive laboratory equipment. Large clinic. Gymnasium dormitory and students' aid dept. Chicago's opportunity for self help unlimited. Enter quarterly. 3-year term. 14th Year.

Ford OWNER Agents Wanted

in each locality to use and introduce

NON-KICK DEVICE

Prevents Broken Arms—Cranking Accidents.

Make big money, part or full time. Burnett sold 144 in two weeks—made $216. Big Field—our folder "How to Make Money With Non-Kick Device" will prove it. Almost 5,000,000 old Fords without starters. 70% 1921 Fords sold without starters, or 875,000 out of 1,250,000.

Try a "Non-Kick" 10 Days at Our Risk

See for yourself how it disengages the clutch, allowing motor to reverse without danger to person who cranks. Thousands of satisfied users. Easy to install; only one nut to remove; slips right on over handle a child can put it on in two minutes. With a "Non-Kick" on your Ford you will never have a broken arm from cranking, with suffering, doctor bills, inconvenience, lost time, etc. Send $2.50 for sample "Non-Kick" Device (or, we will send it C. O. D. and when it arrives pay postman $2.50) and if after 10 days trial it isn't as represented get your money back. Be the first in your locality to order—and ask about attractive exclusive territory offer to agents.

NON-KICK DEVICE COMPANY
765 Central St. Kansas City, Mo.

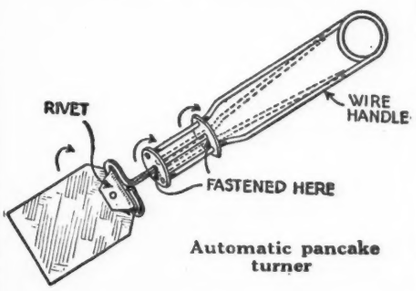
Feeding Work to Breast Drill with Automobile Jack

Homemade drill-press

THE task of drilling a number of holes in an auto spring with my breast drill proved very tiresome. To make it easier for myself, I made a corner bracket of "two by fours" projecting 1 ft. and fastened the breastplate of my drill with wood screws to the upper arm. On the table, about 20 in. below the drill, I placed my auto jack and used it as a drill-press table to raise and lower the work.—JOHN STEIN.

A Squeeze Flips Pancakes Over with This Unique Turner

A PANCAKE turner may be made from a length of wire, two disks, and a piece of tin. Cut the disks 1 in. in diameter and drill three holes the size of the wire to be used 3/4 in. apart as shown. Form a spring in the middle of a piece of wire and shape



Automatic pancake turner

the ends as indicated, making the legs about 5/8 in. apart. Slip the legs through the two outside holes in the disks and by small ferrules prevent them from sliding about.

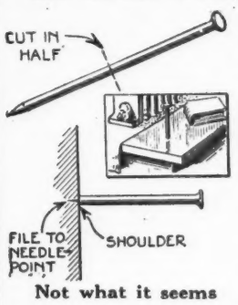
Fasten the shank of another piece of wire in the center holes of the two disks and bend the other end to take a piece of heavy tin, which is riveted in place.

When the handle is squeezed, the legs will tend to cross each other, thus turning the disks and the tin flap and throwing over the pancake.—W. Y. BEACH.

A Mystifying Nail Trick

MUCH fun may be had at the expense of your friends with a large nail prepared in the following manner:

Saw the nail in half, keeping the head part. Now file a needle-point about 1/8 or 3/16 in. long on the cut end, leaving a square shoulder, so that it will look as if the nail had been driven in half way when pushed into a surface. The point being so small, this nail may be pushed into a polished surface without the hole showing after the nail is withdrawn.



Not what it seems

Step Up to a Better Job!

That better job and the bigger pay that goes with it—the job you want—is within your reach. It's only a step to the really big jobs from where you are. That step is simply "knowing how." The practical books for self-training described below will give you that "know how." They are the steps by which you can reach the job you want.

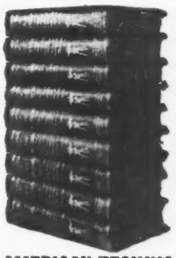
Some of the best authorities in the world wrote these books in plain, everyday language. Anyone with a common school education can understand them. Thousands of pictures, diagrams, etc., make difficult points as plain as day. Over 1,000,000 sets have been sold.

Pay-Raising Books at Greatly Reduced Prices

Automobile Engineering, 6 volumes, 2700 pages, 2400 pictures. Was $30.00	Now	$24.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $25.00	Now	24.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $45.00	Now	39.80
Accountancy and Business Management, 7 volumes, 3000 pages, 2000 pictures. Was $35.00	Now	29.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $20.00	Now	19.80
Electrical Engineering, 8 volumes, 3800 pages, 3000 pictures. Was $40.00	Now	34.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $30.00	Now	24.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $35.00	Now	29.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was $72.00	Now	49.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $20.00	Now	19.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $20.00	Now	18.80
Employment Management and Safety, 7 volumes, 600 pictures. Was $52.50	Now	29.80
Drawing, 4 volumes, 1578 pages 1,000 pictures, blueprints, etc. Was $20.00	Now	19.80

Send No Money
Shipped for 7 Days' Trial

Write the name of the books you want on the coupon and mail it to-day. We will send the books at once, express collect, and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense.



75c a Week

If you like the books, as thousands of other men have after examination, just send us $2.80. You can send the balance of the special reduced price the same way—$3.00 each month (75 cents a week).

Step up to a better job with bigger pay. MAIL THE COUPON NOW. It's your first step.

AMERICAN TECHNICAL SOCIETY, Chicago, U. S. A.

American Technical Society, Dept. X-202, Chicago, U. S. A.

Please send me set of .....

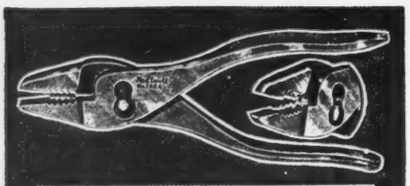
.....

for 7 DAYS' examination, shipping charges collect, I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $3 each month until I have paid the special price of $..... If I decide not to keep the books I will notify you at the end of one week to send for them at your own expense.

Name .....

Address .....

Reference .....
(Please fill out all lines.)



You'll have many uses for a

Red Devil
Reg. U. S. Pat. Off.

Slip Joint Plier

THERE'S no end to the number of things you can make and mend with a pair of "Red Devil" Pliers. You will find them particularly handy around the house, in the garage or on the car.

"Red Devil" Pliers multiply the strength of your hand and wrist; they grip as your fingers can't possibly grip—no slipping, no bruised knuckles, no exasperation from trying to do good work with poor tools.

Forged of tool steel and properly designed to stand years of hard service. They work more easily and make for better results.

Red Devil
Slip Joint Plier No. 1024

shown above, one of the most popular styles for all-around handiness. Made in 7-inch size—beautifully nickel plated.

At reliable hardware dealers everywhere, or from us **$1.25**

Mechanics' tool booklet free.

SMITH & HEMENWAY CO., Inc.
Manufacturers of "Red Devil" Tools
264 Broadway New York, N. Y.

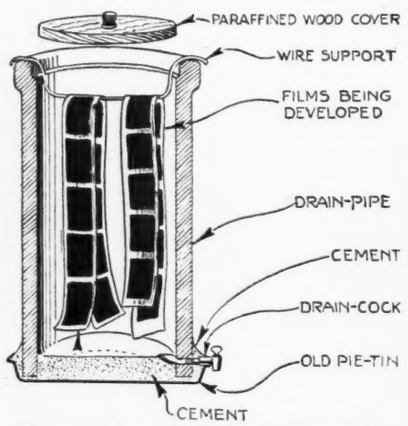
"Red Devil" Glass Cutters—the glaziers standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown below. 20c

Transforming Sewer-Pipe into a Developing-Tank

FROM vitrified sewer-pipe the amateur photographer can easily make a satisfactory developing-tank at small cost. The length of the pipes and their diameter should depend on the number and size of the films to be handled.

In figuring the size of the tank, remember that it need be only half as deep as the film is long, because the film may be doubled face out, while hanging in the tank.

To construct the tank, place the unflanged end of the sewer-pipe upright in a cheap cake-tin, which already has a layer of cement in the bottom. Then pour about 1 in. of cement in the bottom of the pipe and also pour cement around the outside of



Cross section of the developing-tank

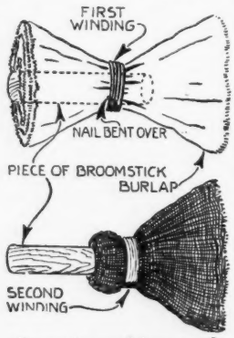
it, filling the cake-tin. If desired, a piece of ½-in. pipe and a faucet may be placed in the bottom of the tank before the cement is poured in.

It is well to make three of the tanks—one for developing, one for fixing, and one for washing the films. After the cement has hardened, it should be coated with acid-proof paint or melted paraffin to protect it from the chemicals.

For supporting the films in the tanks, use heavy wires, bent to hook over the edges of the tops of the pipes, with the lower portions beneath the surface of the solutions. It is important that these supports should be covered with rubber tubing or acid-proof paint.—G. W. GREENE.

This Handy Oil-Swab Is Easy to Make

BY wrapping 2 ft. of 8- or 10-in. wide burlap around an object 3 or 4 in. in diameter, removing it carefully, slipping it over the end of a piece of broom or mop stick, drawing its middle down tight to the stick by means of a winding of string, nailing down this winding of string so that it cannot slip, and then doubling down the part of the burlap that skirts the handle, an excellent oil-swab may be made.—LOUIS SCHNEIDER.



Steps in making swab

"Sloan's *for every muscle in the Human Body*"

Relief for all external pains and aches: rheumatism, neuralgia, sciatica, lumbago, sprains and strains, overworked and sore muscles. Sloan's is good for all of them! *Don't rub—it penetrates.*

Sold by dealers you know and can trust, 35c, 70c, $1.40.

Keep it handy
Sloan's Liniment Pain's enemy

Six Machines in One
—bench grinder, polisher, buffer, sander, drill and saw for working in wood and soft metals.

Handles 4" and 5" grinding wheels; 6" saws; 6" and 8" sand discs, an; ⅜" chuck. Top easily removed. Mountable on separate base with motor. Extremely compact; highly serviceable; decidedly practical. Not a toy. Height, 10". Weight, 31 lbs. Easily driven with 1-4 h.p. motor. Suited for Printers, Cabinet and Pattern Makers, Musical Inst. Mfrs., Furniture Repairmen, Shipping Depts., Manual Training Schools, Laboratories, Private Shops, etc. Machine fully guaranteed.

ONLY $37.85

W. & J. BOICE, 112 23d St., Toledo, Ohio

Music Lessons UNDER MASTER TEACHERS **At Home**

Complete Conservatory Course by Mail

Wonderful home study music lessons under great American and European teachers. Endorsed by Paderewski. Master teachers guide and coach you. Lessons a marvel of simplicity and completeness.

Any Instrument Write naming course you are interested in: Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo or Reed Organ—and we will send FREE CATALOG. **SEND for it NOW!**

University Extension Conservatory · 496 Siegel-Myers Bldg., Chicago

$SAVE MONEY$

MOTORCYCLE & BICYCLE PARTS, ACCESSORIES, TENNIS GOODS, CAMPING EQUIPMENT, CHILDRENS VEHICLES, FISHING TACKLE.

FREE CATALOG

Send us your name for our 1922 72 page Illus. Catalog No. 3. It saves you the middleman's profits of 10 to 25%.

GOTHAM SPORTING GOODS CO.
127 Chambers St., New York City

Dollars in Hares

We pay $7.00 to $18.50 and up a pair and express charges. **Big Profits.** We furnish guaranteed high grade stock and buy all you raise. Use backyard, barn, cellar, attic. Contract and Illustrated Catalog Free.

STANDARD FOOD AND FUR ASS'N
407C Broadway New York

WE TEACH COMMERCIAL ART

Properly Trained Artists Earn $100 a week and up. **Meyer Both College**—a Department of the Meyer Both Company—offers you a different and practical training. If you like to draw, develop your talent. Study this practical course—taught by the largest and most widely known Commercial Art Organization in the field with 20 years' success—who each year produce and sell to advertisers in the United States and Canada over ten thousand commercial drawings. Who else could give you so wide an experience? Commercial Art is a business necessity—the demand for commercial artists is greater every year. It's a highly paid, intensely interesting profession, equally open to both men and women. Home study instruction. Get facts before you enroll in any school. Get our special booklet, "Your Opportunity"—for half the cost of mailing—4c in stamps.

MEYER BOTH COLLEGE of COMMERCIAL ART
Michigan Ave. at 20th St.
Dept. 35 CHICAGO, ILL.

What a Tycos Thermometer will do in your home

INDOORS it shows the healthful temperature—68°; outside, how to dress for the weather. The Fever Thermometer guards your health—the Oven Thermometer assures good cooking—the Candy Thermometer simplifies candy making—the Bath Thermometer indicates the right temperature for bathing in sickness or health.

Your dealer can supply booklets or we will send them direct

Taylor Instrument Companies
Rochester, N.Y. U.S.A.

For Every Industry — If temperature is a factor in your production, there is a *Tycos* or *Taylor* Temperature Instrument—Indicating, Recording, Controlling—for every purpose. T-188

Motorcycle Bargains
SAVE 25% to 65%
on Slightly used and Rebuilt Motorcycles. Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles. Send for **Free Bargain Bulletin and Money Saving Message,** listing hundreds of **Bargains** in used, rebuilt and new machines, supplies, accessories, etc.

AMERICAN MOTOR CYCLE CO.
Dept. 202. 2017 W. Chicago Ave., CHICAGO

You Can Save $50.00

$5.40 and up Parcels Post Paid

By recovering your old auto top frame yourself. We make these recovers to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rear curtain, fasteners, welts and tacks. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.
LIBERTY TOP & TIRE CO. Dept. E8, Cincinnati, O.

$150 to $300 a Month Profit
FROM HB BATTERY CHARGING
Thousands of men, with no previous experience, now making big steady profits with HB Chargers. Universal demand for reliable battery charging—the HB kind. Get started NOW when winter brings biggest demand. Sizes for charging 6, 10, 16 or 32 batteries. Write for information. Small cash payment, balance long, easy terms. Money-back guarantee.

Hobart Brothers Company
Box S27 Troy, Ohio

Big Band Catalog Sent FREE
Anything you need for the band—single instrument or complete equipment. Used by Army and Navy. Send for big catalog, liberally illustrated, fully descriptive. Mention what instrument interests you. Free trial. Easy payments. Sold by leading music dealers everywhere.
LYON & HEALY
72-96 Jackson Blvd., Chicago

2 Tires for $11.25
FREE Tube with Each Tire

Most sensational tire offer of the year! Two tires for less than the usual cost of one—and a free tube with each tire! This is a special lot—all standard makes—selected for record-breaking sale. *No double treads or sewed tires.* Our big volume means best tire values! Thousands of steady customers everywhere are getting full mileage out of these slightly used tires and you, too, can get **8000 Miles**

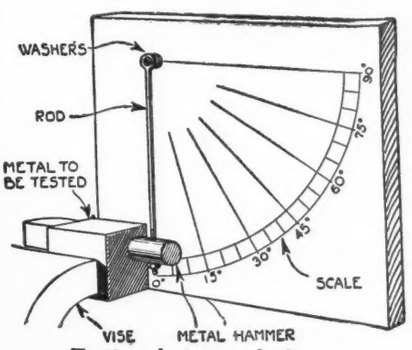
Size	1 Tire	2 Tires	Size	1 Tire	2 Tires
30 x 3	$ 7.00	$11.25	32 x 4½	$13.50	$22.90
30 x 3½	7.95	13.65	33 x 4½	13.95	23.45
32 x 3½	9.00	15.45	34 x 4½	14.45	23.90
31 x 4	10.00	16.90	35 x 4½	14.95	24.45
32 x 4	11.50	19.75	36 x 4½	15.45	25.45
33 x 4	12.25	20.90	35 x 5	15.90	26.15
34 x 4	13.25	22.45	37 x 5	16.45	26.55

SEND NO MONEY! Shipment C. O. D. Express or Parcel Post. Examine tires on arrival and if not fully satisfied return same at our expense and your money will be promptly refunded, including shipping charges. State whether Straight Side or Clincher. DON'T DELAY! ORDER NOW!
ALBANY TIRE & RUBBER COMPANY
2721 Roosevelt Road Dept. 163-B Chicago, Illinois

Homemade Instrument Tests Hardness of Metals

TESTS to determine the relative hardness of various metals may be made in the home laboratory or the classroom with an instrument similar to the one illustrated. The difference in hardness before and after tempering a piece of metal may be observed with the same device.

A hammer made from a small piece of hard steel is fastened to one end of a ¼-in. rod, the other end of which is flattened and drilled to take a bolt passing through the



Testing device ready for use

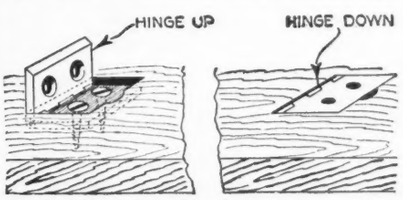
upper part of the 12-in. square board that forms the support. Washers hold the hammer and rod away from the board so that they swing free and clear. A scale marked in degrees from 0 to 90 is attached to or marked on the board as shown.

Place the board and the metal to be tested in a vise and clamp them fast in such a way that the hammer rests against the end surface of the metal and is at the zero position of the scale. Raise the hammer to a horizontal position, as marked on the scale, and let it fall by its own weight. The amount of rebound should be noted as a basis for comparing the hardness of the sample with other pieces or the same piece after heat treatment.

A Serviceable Bench Stop

FOR the home workshop bench a simple but effective bench stop may be made with an ordinary 1½-in. butt-hinge, preferably brass. It will cost only a few cents at the hardware store and can easily be attached.

First chamfer one edge of the hinge slightly as shown in the illustration, to per-



Hinge used as bench stop

mit that half to be raised readily at a touch of the finger. Then chisel a recess in the bench top large enough to let the hinge in flush with the bench top. Screw the hinge in place and cut a thumb hole in the bench so that the upper flap can be lifted up to act as a stop when planing, sandpapering, or otherwise working flat surfaces. If a very thin board is to be planed, put a chip under the flap to raise it just enough to catch the end of the wood without endangering the edge of the tool.—PERCY B. PRIOR.

Do You Want A Better Job?

THE only difference between success and failure is a matter of training. The big men in business today did not reach their present success through luck or chance.

They got into the work for which they were best fitted—and then trained themselves to know more about their jobs than anyone else. When opportunity came—as it always comes—these men were ready to grasp it and turn it into fame and dollars.

You have just as good a chance to succeed as these men had—perhaps better! Good positions are always waiting for trained men—positions that you can get if you train yourself to deserve them.

You can secure this training easily and quickly at home through spare-time study with the International Correspondence Schools, just as so many other men have done. The I. C. S. way is the practical way—the fascinating way—the profitable way.

All that we ask is this:—Fill out the coupon printed below and mail it to Scranton. This doesn't obligate you in the least—but it will bring you the full story of what the I. C. S. can do for you. Today is the day to send in that coupon. "Tomorrow never comes."

TEAR OUT HERE
INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7658-B SCRANTON, PA.
Without cost or obligation, please explain how I can qualify for the position, or in the subject *before* which I have marked an X in the list below:—

☐ ELEC. ENGINEER	☐ BUSINESS MANAG'M'T
☐ Electric Lighting & Rys.	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING
☐ Telegraph Engineer	☐ Railroad Positions
☐ Telephone Work	☐ ILLUSTRATING
☐ MECHANICAL ENGR.	☐ Show Card & Sign Ptg.
☐ Mechanical Draftsman	☐ Cartooning
☐ Machine Shop Practice	☐ Private Secretary
☐ Toolmaker	☐ Business Correspondent
☐ Gas Engine Operating	☐ BOOKKEEPER
☐ CIVIL ENGINEER	☐ Stenographer & Typist
☐ Surveying and Mapping	☐ Cert. Pub. Accountant
☐ MINE FOR'N or ENGR.	☐ TRAFFIC MANAGER
☐ STATIONARY ENGR.	☐ Railway Accountant
☐ Marine Engineer	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Com. School Subjects
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ AUTOMOBILES
☐ Structural Engineer	☐ Railway Mail Clerk
☐ PLUMBING & HEAT'G	☐ Mathematics
☐ Sheet Metal Worker	☐ Navigation
☐ Text. Overseer or Supt.	☐ Agriculture
☐ CHEMIST	☐ Poultry
☐ Pharmacy	☐ Banking

☐ Spanish ☐ Teacher

Name _____ 7-1-21
Street and No. _____
City _____ State _____
Occupation _____

WIRELESS

Hear and Enjoy

Music, Lectures and News of the Day

In Your Own Home

with a Complete

"Marvel" Radio Receiving Outfit

Patents Applied For

Wave length range 180 to 2600 meters.

Receives wireless telephone, music and messages in fifty mile radius of the big radiotelephone broadcasting stations, and radio telegraph signals hundreds of miles away.

No additional parts required; complete in every detail. No source of power, no batteries or other renewable parts needed. No license or special knowledge necessary for installation or operation.

COMPLETE "MARVEL" RADIO RECEIVING OUTFIT, MODEL 105 (as illustrated), consisting of a "MARVEL" Radio Receiver, Model 101 (Patents applied for); 150 ft. copper antenna wire; 1000 ohm telephone with leather covered headband and cord, 5 insulators, antenna switch, ground clamp, Code chart, Abbreviation chart, Booklet of 35 lessons in Wireless and complete directions for installation, all put up in an attractive box..... **$15.00**

Same outfit with 2000 ohm double headset.....$18.00

Buy from your dealer. If he has not yet received his stock, we will ship to you direct on receipt of Postal Money Order. Mention your dealer's name.

Bulletin C-101 on request.

REG. U. S. PAT. OFF.

"MARVEL" OUTFITS are manufactured only by the

Radio Manufacturing Company,

Sales Dept., 170 Fifth Ave., New York City

DESCRIPTIVE ASTRONOMY

By F. M. Moulton

A study of the earth, sun, moon and stars, with a simple explanation of the principles of astronomy.

Price, Postpaid, $2.65

POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York

Guaranteed Five Years

Standard Underwoods!

Greatest Typewriter Bargain Ever Offered

Right now we want to make you the greatest typewriter offer you ever dreamed of. An eye-opener. Only $3 down and this newly rebuilt Shipman-Ward Standard visible writing Underwood will be shipped to you **now**—at a very special price on easy monthly payments or cash.

$3 DOWN

10 DAYS' FREE TRIAL

Let us ship you this machine direct from our big factory. Try it for 10 days and use it in your work. If you or anyone else can get finer work or better service out of any other typewriter in the world, regardless of price, don't keep it. Simply ship it back to us and get your money, together with any express charges you may have paid.

At left is shown the largest typewriter rebuilding plant in the world. Established 1892—325,000 satisfied customers.

TYPEWRITER EMPORIUM

SHIPMAN-WARD MFG. CO.

2142 Shipman Bldg. Chicago, Illinois

THE HOME WORKSHOP

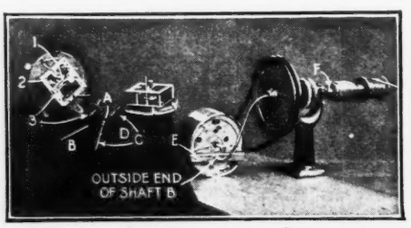
Revolution Counter Built from an Alarm-Clock

A CONVENIENT and reliable revolution counter for registering the turns in winding coils of various kinds in electric repair-shops can be made from an old alarm-clock.

Remove the works and back section of frame and discard all wheels between the back and front sections of frame excepting those numbered 1, 2, and 3. The wheels between the front section of frame and dial plate, which drive the hour hand, should not be disturbed.

Next, remove wheel and shaft No. 3. Take small pinion *A* from this shaft, and press it on one end of the longer shaft *B*, which is a piece of bicycle spoke 2 in. long fitting snugly into the small hole of pinion. Small pinion *D* may be removed from the shaft of the escapement wheel and one section of it pressed on shaft *B* to act as a thrust-bearing against the inside of the back section of the frame.

After the small pinion *A* and the thrust-bearing are placed on shaft *B* and properly



The complete counter and its parts

spaced, the shaft is ready to fit into the original bearing holes of shaft No. 3. In other words, the pinion *A* is placed in its original position, but on a longer shaft. It is necessary to enlarge the bearing-holes sufficiently to permit the insertion of this shaft.

A small hole drilled in back of the case allows shaft *B* to project through a small bearing-hole made in a brass strip *E*, which is soldered at its ends to the case. An old ⅛-in. curtain spring of sufficient length is used as a flexible shaft by fitting one end over the outside end of shaft *B*, and the other over a small stud that threads into the center of the shaft rotating the coil that is being wound.

Suppose a coil of 550 turns is to be wound. Set the hands of clock in upright position registering twelve o'clock. Since each turn of the shaft *F* propels the minute hand, the space of one minute on the dial—60 turns—will drive it completely around the dial. When 550 turns have been wound, the minute hand will have rotated 550 minutes and the clock will register 9 "hours" and 10 "minutes."

Making Plaster Casts Last Longer

PLASTER of Paris flows so freely into a mold and may be worked up readily into almost any shape, that it is frequently useful in the home workshop. The following recipes will increase its durability. The first is to dissolve boric acid in warm water, adding sufficient water to form a borate, and mix the plaster with this solution instead of plain water. The second is to dissolve one part of alum in six parts of hot water and immerse the cast in this from an hour to a week, according to its size and bulk.—E. A. McCann.

RUNNING

the most beneficial exercise

Get all the benefits of a cross country run in your own home, with

SHARP'S Runathome

(Trade Mark)

Portable Track

Just the thing to keep the indoor man fit.

A few minutes daily brings wonderful results. Improved lung power, better circulation and digestion, greater activity of the liver and bowels, and rich, pure blood. Makes the body supple, graceful and erect. Develops the muscles most important to health—those in the abdominal tract, supporting the vital organs. The ideal treatment for obesity. Avoid the stoop and lagging step of age. Keep well and strong with the Runathome.

Simply made, nothing to get out of order. Handles adjustable to any size. Folds up compactly. Size when folded 36 x 20 x 7. Weight, 60 lbs.

Sent anywhere in U. S. A. prepaid for $35.

W. N. SHARP

65 E. Lake Street Chicago, Illinois

MAKE YOUR **FORD** INTO THIS **SPORT CAR** Patterns

The "Pal"

Life Size **Red-i-Kut** $6.40

Other types down to $3.50. Life size patterns and simple instructions show all details. Materials from hardware store and spare time work complete job at quarter factory cost. Order NOW from this ad. Illustrated prospectus showing bodies, tops, windshields mailed for 5c coin.

Keen, Classy Up to the minute

KUEMPEL CO., 86 KUEMPEL BLDG., GUTTENBERG, IOWA

WHY DON'T YOU

Write the Words for a Song?

You can do it. Write about Love, Mother, Home, Comic or any subject and send poem to me at once. I compose Music and guarantee publication.

EDWARD TRENT, 631 Reaper Block, Chicago

BUCHSTEIN'S FIBRE LIMB

soothing to your stump—strong, cool, neat, light. Easy payments.

Braces for all deformities.

Guaranteed 5 Years
Send for Catalog Today.

P-BUCHSTEIN CO., 113 6th St., S., MINNEAPOLIS, MINN.

Learn to Dance

I CAN TEACH YOU Fox-Trot, One-Step, Two-Step, Waltz and newest "up-to-the-minute" society dances in a few hours—at home—in private by the wonderful

Peak System of Mail Instruction

REMARKABLE NEW METHOD. Easy—fascinating.

RESULTS GUARANTEED. No music—no partner needed. Thousands taught successfully.

WRITE ME TODAY for my interesting **FREE BOOK.** Special low offer if you answer at once.

WILLIAM CHANDLER PEAK, M.B.

Studio 38 4737 Broadway Chicago, Ill.

DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my **sworn statement** of how I recovered my hearing.

A. O. LEONARD

Suite 301, 70 5th Avenue - - New York City

Tire Agents Wanted

An auto owner in each locality to use and introduce **Mellinger Extra-Ply and Cord Tires.** Make big money part or full time. No capital or experience needed. Sample Sections Furnished. **GUARANTEED 8,000 & 10,000 Miles** (No Seconds). Hand made. Finest materials. Shipped prepaid on approval.

FREE TIRES FOR YOUR CAR to one user in each locality. Be first to write quick for special Agents Offer and Low Wholesale Prices.

MELLINGER TIRE & RUBBER CO.

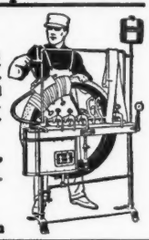
962 North Oak St., Kansas City, Mo.

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2100 Fourth St. Waupun, Wisconsin

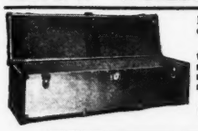
"Lighting Fixtures"

Ready to hang.
Direct from manufacturers.
Completely wired including glassware.

Send for Catalogue No. 20

ERIE FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

KNOW WHERE TOOLS ARE



Keep them safe from loss, theft or damage in a
UNION TOOL CHEST
the kind that every machinist, tool maker, carpenter, plumber, garage mechanic—and every tool owner should have
Write for free Booklet
UNION TOOL CHEST COMPANY
24 Mill St., Rochester, N Y.

The Midget "Five-in-One" Slide Rule

is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add subtract, multiply and divide any combination of whole numbers, fractions mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges.
Price with Instructions, $1.50
Leatherette Case 50c. extra. Catalogue Free.
Gilson Slide Rule Co., Niles, Mich.

BE AN ARTIST

We can teach you **DRAWING** in your own home during spare time.

Our 23 years of successful teaching prove our ability.
10 Courses in Commercial and Illustrative Drawing
Endorsed by high art authorities.

OUR HANDSOME ART YEAR BOOK "FREE TO YOU!"

Students trained by members of our Faculty are filling high-salaried positions. Artist's Outfit **FREE** to Enrolled Students.

Write today for Art Year Book.

SCHOOL of APPLIED ART
ROOM No. 8 BATTLE CREEK MICH.

MOTOR CYCLE
Cleveland
7th Year

75 miles to the Gallon

America's Best Motorcycle Value

A *real* motorcycle (yet safe and sensible) with a two-stroke motor. 75 miles to the gallon—15,000 miles on tires Lowest price.

Write for Catalog "S"

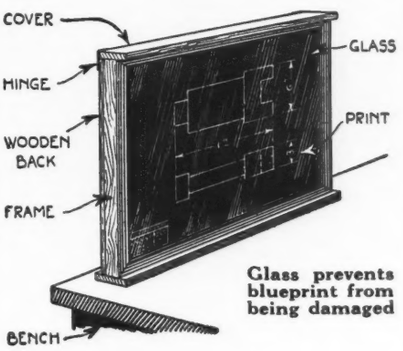
New Price $185

Cleveland Motorcycle Mfg Co.
Cleveland, U.S.A.

THE HOME WORKSHOP

Shop Drawings Protected by a Glass Case

VERY frequently drawings or blueprints that have been borrowed must be used in the shop for reference. Unless unusual care is taken, the drawings will become soiled by handling. The holder shown in the illustration is designed to be placed upon the workbench. It consists merely of a wooden frame with a wooden back and a glass front. The top is hinged so that it may be opened to place or remove the print.

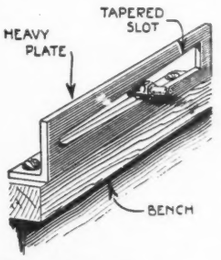


Glass prevents blueprint from being damaged

Aside from keeping the drawings clean, it prevents them from being misplaced and makes errors in reading dimensions less frequent.—K. COGGESHALL.

Wrench-Plate Saves Time at Workbench

THIS wrench-plate attached to a bench near the vise, facilitates the loosening of set-screws in clamps, lathe-dogs, or any portable tools. As used in one shop it serves to hold the shell of spark-plugs while the porcelains are being removed or replaced.



This plate often saves having to use a vise

The fixture is merely a piece of ¾-in. steel plate with a tapering slot, ¼ in. wide at one end and about 2 in. at the other.

One edge of the plate is bent so that it may be screwed to the edge of the bench. The slot should not taper too abruptly.

How Many Index Numbers Does a Tracing Need?

USUALLY the index number on a linen tracing intended for blueprinting is placed in the extreme lower right-hand corner and is repeated upside down in the upper left-hand corner, so that the tracing and prints may readily be found if they are laid in the files in a reversed position.

This practice has many advantages, but also one serious objection. The corners of a tracing are handled more than any other part and the numbers tend to become illegible. Repeating the number once again in a position at least 4 in. and not more than 6 in. from the right edge of the tracing and 2 in. from the bottom will insure the identification of any blueprint.—J. H. VAN NICE.

Here's why Neverslip pliers will outlast and outcut any plier made

PERHAPS you've often wondered why it is that some pliers get dull so quickly. It isn't your fault; it's the fault of the pliers.

Most pliers are made from one piece of steel. Pliers and cutting edges all made at the same time—is it any wonder that they dull quickly and soon have to be thrown away?

It takes time to make a pair of Neverslips. We first make the pliers. Then we make the cutting blades separately, from the finest high carbon crucible steel. These cutting blades are renewable. When one set of blades becomes worn just screw in a new one. It can be done in a jiffy by anyone.

Ask any hardware dealer to let you see a pair of Neverslip Pliers. Look them over carefully. Note the sharp cutting edges and the set of renewable blades. If you want to get *real* action and long life from a pair of pliers, buy Neverslips. If your dealer hasn't them in stock, send us his name and we'll see that you are supplied.

THE NEVERSLIP WORKS
New Brunswick New Jersey

NEVERSLIP side cutting pliers

Neverslip Pliers are furnished in six, seven and eight inch sizes

If you use pliers or buy them for somebody else to use, you'll be interested in our booklet, "Procrastination is Not the Only Thief of Time". It's mailed free upon request. Do you want a copy?

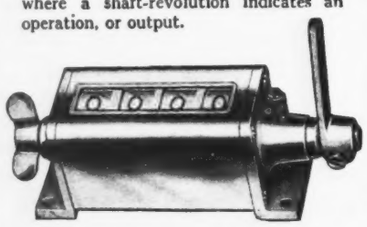
All Count Something!

The inventor or manufacturer counts his machine's output; the storekeeper counts his stock and the amusement manager his attendance; the mechanic counts revolutions-per-minute of motor or machine:

—All because doing things scientifically requires an accurate count of *something*—and some form or other of

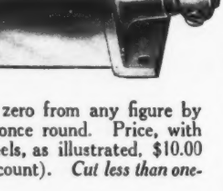
Veeder
COUNTERS

The Revolution Set-Back Counter below records the product of any machine where a shaft-revolution indicates an operation, or output.



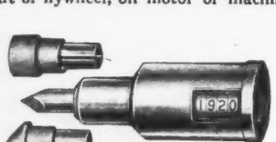
Sets back to zero from any figure by turning knob once round. Price, with four figure-wheels, as illustrated, $10.00 (subject to discount). *Cut less than one-half size.*

The Hand Tally illustrated below is used for counting anything from number of people attending a public place, to number of packages in an inventory. Registers one for each pressure of thumb lever; sets back to zero from any figure by turning knob once round. Price, $5.00.



Speed Counter

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel, on motor or machine.



Push-clutch starts or stops recording mechanism instantly, giving accurate readings without use of stop-watch. With two rubber tips as shown, price $3.50. *Cut less than one-half size.*

Send for free booklet no matter WHAT you want to count—automatically or by hand.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

Bent Shank Prevents Loss or Theft of Tie-Pin

DEVICES for preventing the loss or theft of tie-pins are often expensive, and not easily manipulated, besides revealing their presence by a bulge in the tie. When the shank of the pin is bent as shown

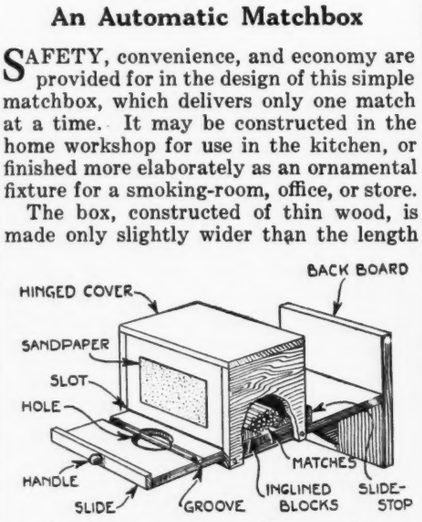
Safeguarding your tie-pin

in the accompanying illustration, the pin is easily inserted but it cannot be removed without attracting notice and it cannot be lost.

An Automatic Matchbox

SAFETY, convenience, and economy are provided for in the design of this simple matchbox, which delivers only one match at a time. It may be constructed in the home workshop for use in the kitchen, or finished more elaborately as an ornamental fixture for a smoking-room, office, or store.

The box, constructed of thin wood, is made only slightly wider than the length

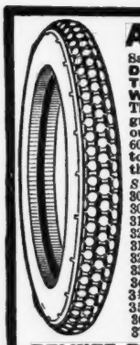


Mechanism of box, which can be ornamented as desired

of a match. It is fastened to a board that serves as a base and is, in turn, attached to a back board and bracket. The back and front of the box are slotted to take a movable slide, which has strips at each end to serve as stops.

The slide has a brass knob or handle and is notched in the middle to carry a single match. A large hole is bored through the center so that a match lying in the notch may be picked up easily. A pair of small beveled blocks are fastened inside the box to guide the matches toward the notch in the slide.

Each time the slide is drawn out, it will carry one match with it. If desired, a spring can be fitted to draw it back automatically.—HARRY G. SCHULTZ.



AUTO OWNERS

Save half of your tire cost by using Double-Mileage, Double-Tread Tires, Guaranteed 6000 Miles. We lead, others try to follow. They are reconstructed of highest grade material—hardly ever blow out. They are only guaranteed for 6000 miles, but have run from 8000 to 10,000 miles. Order today at these low prices:

Size	Tires	Tubes
30x3	$5.50	$1.60
30x3½	6.50	1.75
31x3½	6.75	1.85
32x3½	7.00	2.00
31x4	8.00	2 25
32x4	8.25	2.40
33x4	8 50	2.50
34x4	8.75	2.60
31x4½	10.00	3.00
35x4½	11.00	3.15
36x4½	11.50	3.40
37x5	12.75	3.75

RELINER FREE WITH EVERY TIRE

Send $2.00 deposit with each tire ordered, balance C. O. D. Tires shipped subject to your examination. State whether S. S. or Cl., plain or non-skid is desired. All same price. By sending full amount with order you can save 5%—our special cash-with-order discount.

DOUBLE MILEAGE TIRE & RUBBER CO.
2035 W. Harrison, Dpt. 102, CHICAGO, ILL.

COLD PIPE BENDERS

Standard of the World

HAND and MOTOR OPERATED
14 sizes of machines
What it costs to bend pipe our way, per bend

1-in. Pipe, 5 cents 4-in. Pipe, 25 cents
2-in. Pipe, 10 cents 6-in. Pipe, 40 cents
8-in. Pipe, $1.00.

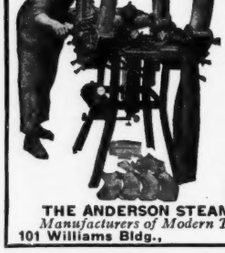
Send for catalogue
American Pipe Bending Machine Co.
51 Pearl St. Boston, Mass.

10c CHARGES Storage Battery

At Home With an F-F BATTERY BOOSTER, which is a Magnetic Rectifier for 105-125 Volt 60 Cycle A.C. Snap Clips of Charger on battery terminals. Turn Switch and Battery will be Charged in morning. No skill required. AMMETER Shows Current. Complete Compact Portable Charging Unit. Do not think your battery is dead and worn out simply because it will not start your car. Buy a Booster and Fill it with Life. Booster Saves You Money. Lasts Life Time. PRE-WAR PRICES:
Bantam Type 6 charges 6 volt battery at 6 amps $15
Bantam Type 12 charges 12 volt battery 6 amps $15
Type 166 charges 6 volt battery at 12 amperes $24
Type 1612 charges 12 volt battery at 7 amperes $24
Type 1626 Combination Type charges both 6 and 12 volt batteries at 12 and 7 amperes $36

The Large Types are for heavy batteries, or where time is limited. Shipping Weights Complete with Ammeter & Battery Clips, 12 to 15 lbs. Send check for Prompt Express Shipment; or for Parcel Post Shipment add Postage and Insurance charges, or Order Type desired sent C.O.D. Order Now, or Write for FREE Descriptive FOSTER Bulletin No. 17. For GROUP Charging ask for Free ROTARY RECTIFIER Bulletin 17-R.
THE FRANCE MFG. CO., CLEVELAND, OHIO, U. S. A.
Canadian Representative: Battery Service & Sales Co., Hamilton, Ontario

START IN BUSINESS



Make Real Money on Small Capital

All over the U. S. and Canada we are establishing Vulcanizing Service Stations. Start one in your town. Make $10 to $30 per day on a $350 investment. We instruct you and furnish the *Most Modern Methods and Equipment*—

THE ANDERSON
Known the World Over

We have 34 Schools in U. S. and 4 in Canada. One is near you. School pays you $5 per day while learning to operate your station. Write for full particulars—TODAY.

THE ANDERSON STEAM VULCANIZER CO.
Manufacturers of Modern Tire Repair Equipment,
101 Williams Bldg., Indianapolis, U. S. A

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous **BELL ASBESTOS MINES,** in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

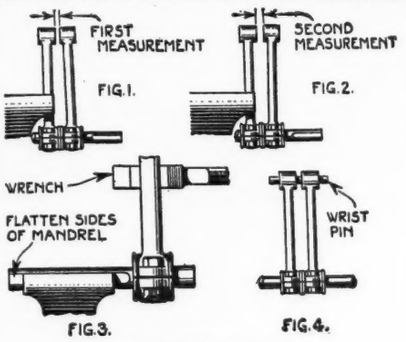
For anything you want in Asbestos turn to

Keasbey & Mattison Company
Dept S-4, AMBLER, PENNA., U. S. A.
Owners of the World's Largest Asbestos Mines

THE HOME WORKSHOP

Way of Fitting and Testing Connecting-Rod Bearings

FITTING connecting-rod end bearings is facilitated by the use of a mandrel the exact diameter of the crankshaft, and this method has advantages over fitting direct to the crankshaft in that the work can be done on the bench with the mandrel clamped in a vise. This avoids working under the car when the crankshaft has not been removed, and the bearing cap need not be removed when spotting the bearing for scraping, as the connecting-rod is pulled over the end of the mandrel. It is essential



Steps in adjusting bearings

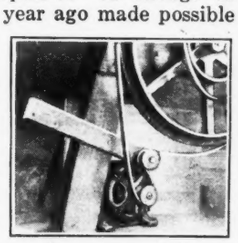
that the diameter of the mandrel be the same as the size of the crankshaft. Where different cars are repaired, several sizes of mandrels are required.

These mandrels can be used for testing the straightness of the connecting-rods after the bearings are scraped. To test, one connecting-rod is held in the vise with the mandrel through the end. The other connecting-rod is placed over the mandrel and brought against the cap of the first. The space between the wristpin ends is measured and the connecting-rod pulled off the mandrel and reversed. A second measurement is taken between the wristpin bearings. Where these differ, the end of the connecting-rod is bent in the correct direction to make the measurements identical. When one rod is straightened, this is used as a gage for straightening the other rod. With both rods straight, one of the wristpins is used as a final test for straightness.

With both connecting-rods on the mandrel, the wristpin should slide through both wristpin bearings. If it does not it will require slight twisting of the rod with a wrench to line up the wristpin holes.

A Simple Belt-Tightener

FOR many years the writer drove his lathe with footpower. A change of residence about a year ago made possible the added convenience of electric power, but certain conditions rendered it impracticable to hook up the ¼-hp. motor and the lathe with a countershaft. The method illustrated was therefore adopted.



A countershaft substitute

It consists of nothing more than a loose belt and two flanged pulleys, one on the motor and the other on the belt-tightener. This arrangement has worked wonderfully well and has never slipped when the hardest cuts were being made on the lathe.

The superior accuracy and quality of Starrett Tools is shown by the fact that toolmakers as a class prefer them. These men know the importance of using precision tools of the highest accuracy. The worth of Starrett Tools to men of lesser skill is even greater—because they need the aid that only fine tools can give.

Write for free copy of Starrett Catalog No. 22 "W," describing and illustrating 2100 fine tools

THE L. S. STARRETT COMPANY

The World's Greatest Tool Makers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

Use Starrett Tools

17-255

How To Conduct a Radio Club

BY E. E. BUCHER. Covers parliamentary procedure, indoor and outdoor experiments, 5,000-mile receiving sets, vacuum tube amplifiers and detectors and many other subjects. **Paper Cover. 148 pages. Fully Illustrated. Price 75c**

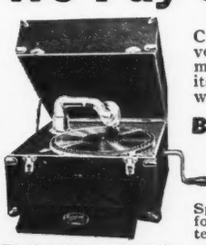
POPULAR SCIENCE MONTHLY 225 West 39th St., N. Y.

Consolidated Radio Call Book

The Wireless Encyclopedia for data on **Shore Radio Station Calls, Ship Radio Calls, Telegraph, Cable, and Radio Rates, Radio Compass Stations, Press Schedules, Weather Reports—Time Schedules, Amateur Radio Calls. Paper. 6x9¼ in. 160 Pages. Price $1.25**

POPULAR SCIENCE MONTHLY 225 West 39th St., N. Y.

We Pay $9 a Day



Taking orders for Music Chest. A marvelous invention. Does more than machines costing ten times its price. Easily carried with you anywhere.

BIG OPPORTUNITY

for any man working spare time or full time. Easy to take orders on account of low price. Biggest proposition ever offered to our Special Representatives. Write for demonstrating sample, terms and territory.

THOMAS MFG. CO., Chest 447 Dayton, Ohio

NEW MOTORS FOR ALL PURPOSES. STANDARD MANUFACTURERS PROMPT DELIVERY

ALL SIZES UP TO 5 H.P.

We Specialize In Small Motors & Generators

ALL PHASES AND FREQUENCIES IN STOCK AT ALL TIMES

Largest exclusive Mail Order Small Motor dealers in the world.

CHAS. H. JOHNSTON, Box 14, West End, Pittsburgh, Pa.

WIRELESS TELEPHONE GENERATORS
500 VOLT - 100 WATT - 3400 R. P. M.
FOR MOUNTING MOTOR GENERATOR SETS.

$28.50 EACH

WRITE FOR CATALOG

REDUCED PRICES

Back to Normalcy—20% Further Reduction

SOUTH BEND LATHES—EST. 1906

	Standard Change Gear	Quick Change Gear		Standard Change Gear	Quick Change Gear
9"x3' Lathe	$176.00	$216.00	16"x 8' Lathe	$452.00	$512.00
11"x4' Lathe	228.00	273.00	18"x10' Lathe	656.00	721.00
13"x5' Lathe	304.00	354.00	21"x12' Lathe	848.00	923.00
15"x6' Lathe	376.00	431.00	24"x14' Lathe	1140.00	1230.00

Free Catalog No. 67

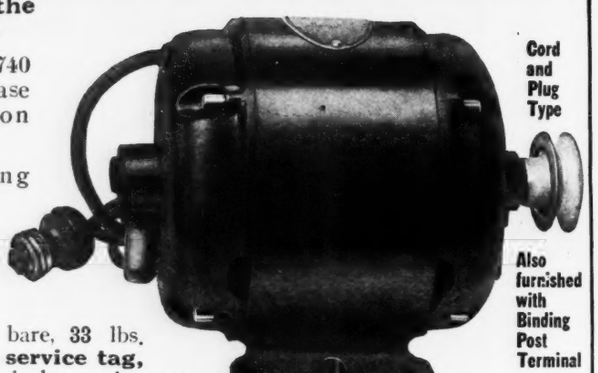
SOUTH BEND LATHE WORKS, 433 E. Madison St., SOUTH BEND, IND.

Guaranteed $13.50 ¼ H-P A.C. MOTOR F.O.B. Chicago

This is lower than the before-war price

Motor is 110 volt 1740 rpm, 60 cycle, splitphase fan-cooled induction type.

Suitable for running washing machines, churns, cream separators, ventilating fans, blowers, lathes, drills, etc.



Motor weighs 24 lbs. bare, 33 lbs. boxed. **A guarantee service tag,** serially numbered is attached to each motor shipped. It guarantees purchaser a new motor by express prepaid, should defects develop within a year. Repair parts are always available at low cost. Price complete, boxed, f.o.b. Chicago $13.50.

Quality Discounts. On 3 motors ordered in 1 shipment price is $13.00; six motors, $12.50 each; 12 motors, $12.25; 25 motors, $12.00 each.

Send cash with order or we will ship by express C.O.D. if you prefer

Descriptive circular on application

NORTHWESTERN ELECTRIC COMPANY

410-420 SO. HOYNE AVENUE, CHICAGO

B·S

THROUGHOUT the years Brown & Sharpe Tools have led the way in accuracy, quality and workmanship. These *superior* tools repay you through their long wear, and with the help they give you in doing your work better.

We shall be glad to send a copy of our No. 28 Small Tool Catalog.

BROWN & SHARPE MFG. CO.

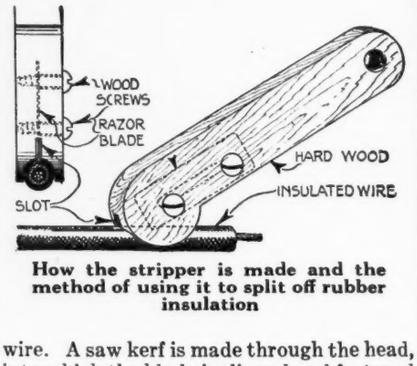
Providence, R. I., U. S. A.

THE HOME WORKSHOP

Stripping Off Insulation with a Razor-Blade

REMOVING the covering from electric wires for splicing purposes is slow and tedious work when done with a knife, especially if there is very much of it. The tool shown in the accompanying illustration, if carefully made, will render the task much easier.

A piece of hard wood is cut to the shape shown and slotted so as to slide over the

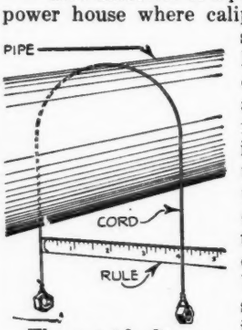


How the stripper is made and the method of using it to split off rubber insulation

wire. A saw kerf is made through the head, into which the blade is slipped and fastened with small bolts. In use, the stripper is drawn, with slight pressure, over the insulation to be cut away, splitting the rubber so that it may be removed with none of the usual trouble of scraping.—W. E. KING.

Measuring Outside Diameter without Calipers

HAVING recently to measure the outside diameter of a pipe in a navy-yard power house where calipers were not instantly available, I devised the quick and reasonably accurate method illustrated in the sketch. I tied two nuts to the ends of a piece of string and threw one of them over the pipe. When they stopped swinging, it was a simple matter to measure the distance between the cords, which was the outside diameter of the pipe close enough for any ordinary purposes.—JOSEPH E. ROONEY.



The outside diameter is the distance between cords

How to Bend a Teaspoon for Baby's Use

BABY'S tiny hands are not steady in handling a regular teaspoon, but it is not difficult to make a special spoon for him to use. Simply bend an ordinary spoon over some kind of a cylinder until it is shaped as shown in the illustration.

Baby's improvised spoon

With this spoon the baby will not be so apt to spill food over his high chair or, worse still, over the table.—FRANK HARAZIM.

Automatic Electric Hopper Feeds Hens Regularly

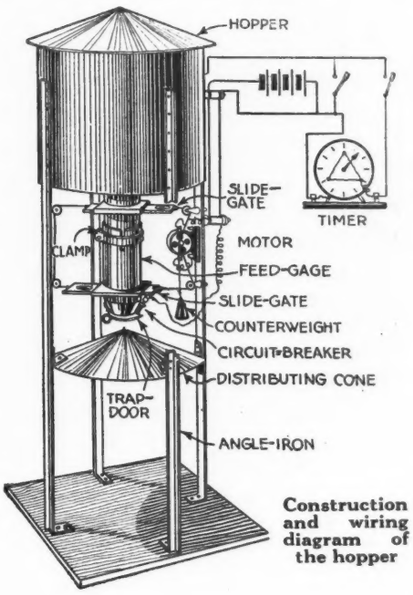
By Edwin G. Gettins

RAISING chickens has become a highly scientific business and the modern poultry fancier employs many mechanical devices to simplify his work. To get the maximum number of eggs, the hens must be given balanced food at regular intervals; neglect means an immediate drop in egg production. An electrical chicken-feeder that will automatically release a fixed quantity of feed at regular intervals can be made by any one who is handy with tools.

The device consists of a galvanized iron hopper with a conical top and bottom. The bottom has a cylindrical extension in two pieces, the upper half telescoping into the lower and each containing a slide gate. The lower half terminates in a truncated cone, the orifice of which is closed by a spring trapdoor. Here a circuit-breaker is located. An angle-iron framework supports the hopper, distributing cone, pulleys, motor, and insulators. At any convenient point in the house or garage are located the electric controls, which consist of two knife switches and a timer.

The timer is made of an alarm-clock with the minute hand removed. Holes are drilled through the glass opposite the numbers desired as feeding-hours; for example, 8, 12, and 4. Into these holes are cemented fine steel wires just long enough to come into contact with the hour hand as it passes. The wires, joined by a triangular connection outside the glass, are connected with one terminal and the frame of the clock to another.

When the circuit is closed at the fixed hours, the motor is started. The motor shaft is connected with a spindle having a rough surface, which winds a line fastened to both upper and lower slide gates in such a way that, with the assistance of a line connected at the opposite sides of the slide gates, the upper slide is moved into a closed position and the lower slide is moved into an open position. The feed then falls against the spring trapdoor and opens it. That closes the circuit-breaker, which keeps the motor rotating, although by this time the hand on the timer has passed the fine steel wire. The feed falls on the distributing cone and is scattered on the ground. While operating the slide gates, the motor is also winding up a counterweight.



Construction and wiring diagram of the hopper

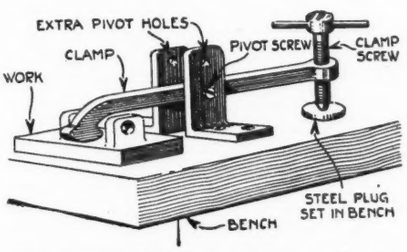
The circuit-breaker is a piece of flat brass bent up at the ends and drilled to allow the free passage of a hard rubber rod capped with a brass disk that has a copper loop soldered to the top for connecting the wire. It is riveted on the feed measure so that when the spring trapdoor is closed, the rubber rod is pushed up far enough to keep the two brass parts separated. When the feed measure has been emptied, the trapdoor closes and pushes up the rubber rod in the circuit-breaker, opening the circuit. The action of the counterweight then closes the lower slide-gate and opens the upper slide-gate, thus charging the feed measure for the next feeding.

Heavy flax fishline is best for the lines. The pulleys can be purchased at any hardware store. The spring that closes the trapdoor can be made by twisting a piece of spring wire around an iron rod. The quantity of feed may be changed by loosening the clamp and lengthening or shortening the feed measure.

When using this feeder, you may throw the switch on the timer and leave the house at 6 o'clock in the morning for an all-day trip, knowing that your chickens are being properly cared for during your absence. The timer must be disconnected each evening to prevent the device from operating during the night.

Quick-Acting Bench-Clamp for Awkward Pieces

AN adjustable quick-acting clamp, particularly useful for holding irregularly shaped pieces, may be made as shown in the illustration. The nose of the clamping-bar is so shaped that it will go between bosses, lugs, or other obstructions.



This clamp holds irregular pieces firmly

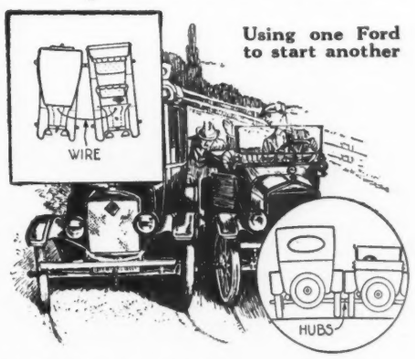
The pivot screw is threaded to fit a tapped hole in one angle-iron, but is merely a straight fit in the other angle. By tightening the clamp screw great pressure can be exerted on the nose of the clamp. If the work is very thick, the pivot is moved up to the higher holes.—J. H. MOORE.

More Ways than One to Start a Balky Ford

WHEN a Ford is hard to start, it is frequently found that the trouble is not weak magnets, but merely magnets that do not stand close enough to the coils because of bearing wear. A permanent remedy is to install a new rear main bearing.

• If an engine becomes balky on the road, due to this difficulty, it is still possible to start it, and, once running, it will continue to go. One method is to jack up the rear drive wheel and crank the engine by turning the wheel. Under these circumstances the magnets are forced a little closer to the coils, whereas cranking in the usual way tends to pull the magnets slightly away from the coils.

A still easier method is possible when another Ford is available, and some of the current in the second car can be used to help start the first. The second car is driven alongside the first so that the hubs are in contact and make a good ground connection. Then run a wire between the primary lead-posts of the two magnetos.



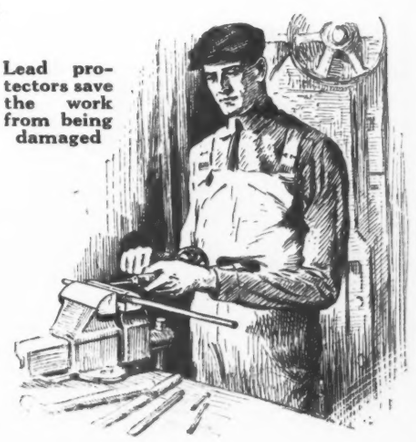
Using one Ford to start another

While the engine of the second Ford is racing, crank the first car in the usual way. This method will not fail if the trouble is due to crankshaft end play.

THE small carbon rods which are part of the ordinary pocket lamp battery can be filed and trimmed down to make a very acceptable temporary replacement for out-out carbon brushes in the magneto.

Lead Protector Made to Prevent Vise from Marring Work

WHEN holding carefully machined work or small parts in a vise, there is always danger of the jaws ruining the finish. One workman prevented this by making a lead protector. He obtained two pieces of sheet lead about ⅛ in. thick and 1 ft. long and cut them to the width of the jaws. Then he bent one piece over each jaw, the lead being easily formed to the proper shape.



Lead protectors save the work from being damaged

Although the lead is soft enough to yield to the work that is being clamped in the vise, it is firm enough to hold the material fast. When not in use, the pieces of lead can be taken out and laid aside without a moment's loss of time.—CLEMENTINE PADDLEFORD.

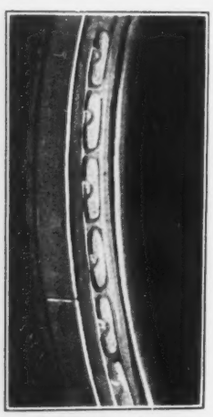
How to Retread Your Own Auto Tires

By L. B. Robbins

THE rubber on an automobile tire acts as a waterproof coating and a protection to the fabric against wear. When the rubber over the tread has worn away, water can enter and rot the fabric, and friction with the road will tear it apart and cause premature blowouts. That is the reason for retreading; it prolongs the life of the tire, provided there are no weak spots in the side walls or bead. But retreading is somewhat expensive when done professionally. As a substitute, the following cheap home method will give excellent results.

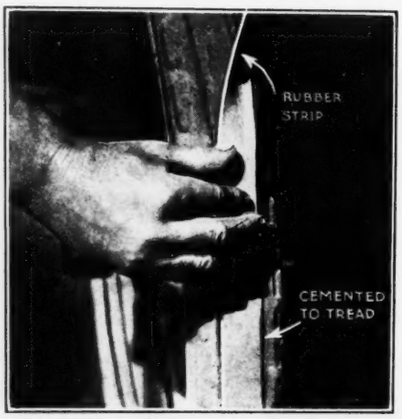
Take the tire before the tread is badly worn through, inflate it to full pressure, and clean it off thoroughly with gasoline. Then sandpaper it as if preparing to patch an inner tube. Wash it a second time with gasoline.

Next, unroll a strip of patch rubber, which is nearly pure gum rubber and may be bought in pieces 24 in. long by 3 in. wide. Lay it on a board and with a sharp knife cut it into two strips 1½ in. wide and 24 in. long. Apply a good coat of self-curing patch cement, rubbing it well over the edges of the rubber. Then let it nearly dry. When the cement is tacky, pick up the strip with both hands and lay it lengthwise in the exact middle of the tread. Pat it gently from end to end with a smooth piece of board until every portion is in perfect contact with the tire.



Strips in place

Treat a second piece of rubber in the same manner and apply to the tread, butting the end against one end of the piece previously applied. Continue this until the whole circumference of the tire is retreaded. If there are any visible breaks between the abutting sections of rubber, fill them in with some good tire "dough" or putty, which will self-vulcanize and make the retread endless.



Attaching the strips with cement

When completed, lower the tire to the floor and slowly push the car backward and forward several times to press the retread firmly on the tire and to eliminate any possible air bells. Jack up the wheel again and leave it there several hours before using.

The tire in the photograph, as well as another one on the same car, were retreaded in this manner and have been in constant road service for over three months. The retread has not yet worn through. Needless to say, when it does show signs of wearing, it will be torn off and a new one substituted. Two pieces of patch rubber will just cover one 30 by 3½ in. tire when prepared as directed at a cost of about 75 cents. Isn't it worth trying?

[A tire-retreading expert who read this article remarked that most men in that business would say Mr. Robbins' feat was impossible, but that he assuredly would try the method himself on several tires. The surprising part is that nearly pure stock stays so well in place and wears so long as it did in this experiment.—THE EDITOR.]

Storm Sash Will Cut Your Coal-Bills

STORM sash, or double windows, on the cold sides of the house, will increase your winter comfort and make possible a surprising saving in fuel. It is a carpenter's job to make them in the ordinary way, but the method illustrated in the accompanying drawings is so simple and effective that no man who is at all handy with tools need hesitate an instant to undertake the work.

All you will need in the way of tools are a cross-cut saw (a ripsaw, too, if you happen to have one); a try-square; a hammer and nail-set; brace and ⅜-in. bit; a plane such as a fillister, rabbet or dado, or one of those jack-planes that has had a groove cut in it and can be made to serve for taking out a rabbet by simply bradding suitable small strips of hard wood to guide the width and depth of the cut; a sharp chisel; a sharp plane to square the edges and smooth off the surface. Glue, 3½-in. finishing nails and ⅜-in. dowels will be necessary, and a miter-box with an accurate square cut in it will be a great aid. You will be able to make use of a compass saw and hand screws if they are available.

First cut two measuring-rods to fit neatly in the opening where the sash is to go. Cut a bevel on the height rod to fit the sill.

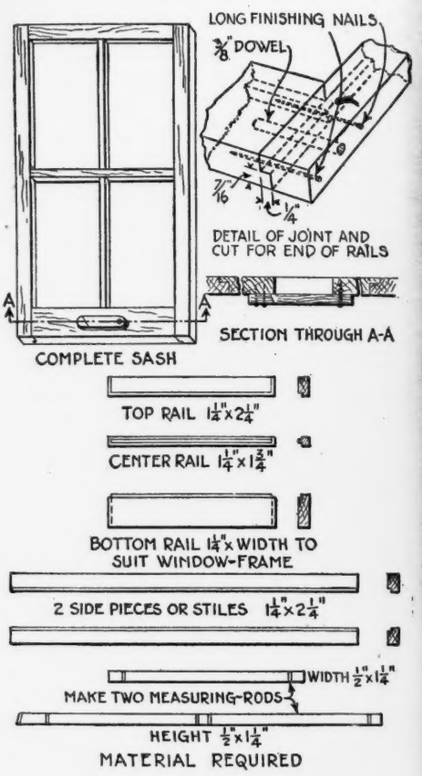
Lay out the rods as shown, making the center rail come opposite the meeting rail or check rail in the regular sash. Make all lights of glass the same size and have the bottom rail wide enough to make up the difference. Usually, that will be about 5 in.

Cut out all the pieces to the widths as shown and lengths as marked on the rods. Be sure to cut the rails off square and true in the miter-box or test them with the try-square. The rails should be cut to the longer of the two marks on the width rod, that is, 4 in. less than the full width of the sash.

Now, with a plane prepared to cut a rabbet ¼ in. deep, work all the pieces as shown on one edge only, except the center rail, which is rabbeted on both edges. Also with the plane bevel the bottom edge of the bottom rail to the angle taken from the height rod.

In the ends of each rail make a square cut as illustrated in the perspective detail the exact depth necessary (it will be about 11/16 in.). Carefully make a line on the end grain and remove the loose wood with a chisel or a fine saw. Rail and stile will then fit neatly together.

The sash is now ready to be nailed and doweled together. The joints must be held with handscrews or some other device as the nails are being driven, otherwise the surface at the joints may be uneven. Drive two long, thin nails at each joint, near the edges of the top and bottom rails and sink them in deep with the nail-set. Then make sure the sash is perfectly square. It is best to nail on a brace to hold it temporarily true. Next bore a ⅜-in. hole between the



The joints are first nailed and then bored for dowels

nails in each joint and drive in a dowel at least as long as the nails.

The two vertical bars as shown in drawing may now be made from pieces left over, fitted in tightly, and nailed with 1-in. brads.

The bottom ventilator is best cut out by boring a hole with an expansion bit and brace as large as is desired at each end and cutting the remainder of the slot with a compass saw.

The cover is put on the inside and is about 3 in. longer than the vent and ¾ in. wider. It is made in one piece and then cut at the angles shown, the small piece being bradded on to the sash, the long piece swinging on a screw.

Opening Up Screw-Eyes, Hooks, and Links

PLACE the link in a vise or hold it with a pair of pliers; with another pair of pliers give the eye end of link or hook a twist sideways, which opens the eye easily and without breaking, and is easily closed up again. —O. A. JOHNSON.

Opening a link